Vol. XVIII. January, 1900. No. 1.

PAVING SEWERAGE

MUNICIPAL ENGINEERING

WATERWORKS PARKS

A MONTHLY MAGAZINE.

DEVOTED TO THE IMPROVEMENT OF CITIES.

GOOD ROADS, STREET CONSTRUCTION,
CLEANING AND LIGHTING,
SANITATION,
BRIDGES.

PUBLISHED BY
MUNICIPAL ENGINEERING COMPANY
INDIANAPOLIS NEW YORK

LIBRARY OF CONGRESS
FEB 17 1902
COPYRIGHT DEPOSIT

Two Dollars Per Year. Single Copies, 25 Cents.

SPECIAL NOTICE

TO CHIEF ENGINEERS OF CITIES AND TOWNS WHERE PAVEMENTS HAVE BEEN LAID BY COMPANIES CONTROLLING and RESTRICTING THE ASPHALT THEY USE UNDER LONG TERM GUARANTEES and where the guarantees have expired

Save the Money of Your City and Buy Your Asphalt from Us

Make Your Own Repairs from Time to Time as Needed—Avoid Exhorbitant Maintenance Contracts

WITH THE ORIGINAL BUILDERS

UVALDE ASPHALT COMPANY

No. 1 Broadway, New York

Municipal Engineering

VOLUME XVIII. JANUARY, NINETEEN HUNDRED. NUMBER 1.

THE PREVENTION OF ELECTROLYSIS.

By Alton D. Adams, M. A. I. E. E.

Since the early days of the telegraph the earth has been sought as a conductor in electrical distribution for the transmission of intelligence and of energy for lighting and power. Of the several purposes for which the earth has been called to serve as a conductor, telegraphy alone has been accomplished in a manner satisfactory to its users and without damage to other tenants of the soil. Telegraph circuits, therefore, seem likely to be completed in the future as in the past, through the earth, because telegraph instruments are not apt to be seriously affected by earth currents and because energy passing in telegraph circuits is too small to menace other interests. The telephone interests, in their early development, followed the lead of the telegraph in the use of the earth for a part of their circuits, and the amount of energy here involved was again too small to put other occupants of the ground in danger. It soon became evident, however, that earth currents from other sources, especially those of the growing street railway industry, seriously affected the satisfactory operation of telephone instruments. Suits were brought against the electric railway companies, but it was decided that no recovery could be had for the effect of earth currents from other sources on the working of telephone apparatus. As a result the earth has been generally abandoned as a part of telephone circuits. During the early development of electric lighting attempts were made to use the ground as a conductor, but results as to safety and efficiency were unsatisfactory, the plan was opposed by the insurance interests and was long ago abandoned.

The great development of electric railways using current from a circuit of which the overhead trolley forms one side and the rails, earth and ground conductors the other, has made the flow of electric energy through the soil in large amounts, common in most cities and large towns.

The presence of heavy electric currents in the ground is quite certain, under the ordinary conditions of soil, so long as the dynamos, rails and ground wires are designed and connected as at present. To fully appreciate this, a glance at the usual construction of what is known as the return circuit of electric railways is desirable.

In common practice the rails are bonded across their joints; that is, a wire or rod of copper is securely fastened to the end of each rail,

and then to the end of the next, so as to give the joints between the rails as low an electrical resistance as possible. Those parts of the track system nearest to the electric generating station are connected, at one or more points, with that pole or terminal of the dynamos at which the current enters, by a heavy copper cable.

In the larger and better built street railway systems additional copper cables are laid from that pole of the dynamos just named to various distant points of the track system, and there connected with the rails. These ground feeders or track feeders, as they are called, are more commonly bare, and laid directly in the earth, but in some cases have been insulated and put in conduits. It is also common to lay a bare copper wire between the tracks, and connect it to each rail, in which case it acts to increase the total conductivity of the track, being joined at one end to the same terminal of the dynamos as the rails. With the system just described, all of the cables and the rails act together to convey current to the power station.

As the rails, and usually the ground wires and feeders named, are in direct contact with the ground, the electric current from any part of the system may flow to the end or part of the track nearest the power-house either by the several wires and rails or through the earth and such conducting bodies as it may contain. It is a law of electric currents that they divide between the several conductors that exist in any circuit, in the inverse ratio of the resistance of each conductor. Compared with the resistances of track and ground wires common in electric roads, the soil and the metallic pipes it contains commonly offer a sufficiently low resistance to induce a considerable flow of current therein.

In a large system of tracks it frequently happens that the electric pressure at one point is much greater than that at another point, and a current is then quite sure to flow through the ground, as the conductors buried in it, from the point of higher to that of lower pressure, though both points may be at about the same distance from the power-house.

As has been amply shown, these currents from electric railway lines are doing a large amount of damage to gas and water pipes, and that of a kind that gives no warning of its presence until a bad fault occurs and the service is interrupted. The damage to pipes is usually worse in those cases where they run parallel and quite close to tracks for some distance, or where they intersect with two or more lines of track at points of different electric pressures.

Cast-iron water pipe offers a fairly good path for electric current in each section, and the main damage is done at points where current leaves the pipes. It has been presumed that current usually leaves a line of water pipe mainly at one or more points near the generating station, or some part of the track or system of ground conductors. Acting on this supposition, water pipes have been connected by cables with the rails and with ground conductors entering the power-house, so as to make the pipe-line as good a path as possible for the electric current, and to prevent the flow of current from the pipe to the soil. It is now known, however, that a large part of the current flowing in any water pipe line leaves the pipe at each joint and enters the next length of pipe after passing through the water

SNOW DUMP ON THE BOSTON COMMON.

and earth for a few inches. The resistance of water pipe joints has been found to be a very large part of that for the entire line and is large compared with that of the earth on the outside and the water inside the pipe. Instead, therefore, of one, or at most a very few main points at which a current leaves a line of water pipe, as formerly supposed, a large portion of the current, in any case, leaves each length of pipe at the joint, only to enter the next length. It is, therefore, evident that all constructions which tend to divert current from the rails or the soil, such as connection by cable between the rails and the pipe line, or from the line to the power station, simply extend the damage they are designed to prevent by causing a path of less resistance to exist by way of the pipe line and thus sending more current through it.

The safest course as to water pipe lines is to keep them as free as possible of contacts with the ground returns of electric roads. This course alone, however, is no guarantee that pipes will not be destroyed by the electric current. The certain remedy is pointed out later on. The injury to water pipes is perhaps more serious than that to other metallic structures in the soil, but they are by no means the only ones to suffer. Gas mains are attacked in a manner similar to those for water. So also are iron conduits for electric wires. The lead coverings of electric cables are subject to injury unless protected by conduit or other means.

In the case of lead covered cables, however, the danger may be reduced to some extent by metallic connection of the cable to the rails and return wires at the proper points, since the lead covering is continuous and not broken up into short lengths by joints, as is the case with water pipes.

The extensive use of steel beams or rails in the foundations of large buildings is now common and it is suspected that groups and rows of such buildings may have beneath them a path of such low resistance as to receive large volumes of current from the street railway in large cities. When the foundations of such buildings are weakened through the destruction of their steel members, the most serious results may be expected. The remedies usually applied to prevent the destruction of metal structures underground are inoperative, uncertain, or partial. The great interests involved demand a general and complete solution of the problem, and such a one must soon be adopted, if a very large amount of property all over the country is to be saved from destruction. It may be assumed at the start that an adequate remedy will cost money, but it is very certain that its cost will be trifling compared with the value of property thus saved from ruin.

A complete remedy for the injurious action of ground currents from street railways must be found through a clear understanding of the conditions that produce them and then the removal of these contions. In order that an electric current may flow in any substance there must be a difference of electric pressure between two points in that substance. Thus, in order that an electric current shall flow from the tracks and ground wires of a street railway system to the generating station, there must be a higher electric pressure at the tracks than exists at the station terminals where the current enters. Again, if current is to flow from one part

of the track system to another part, there must be a variation of pressure between the two. On the existence of different electric pressures of various points in the tracks and return wires of street railways, and the contact of these parts with the ground, depends the flow of current through the soil, water pipes and other buried conductors, with their injurious results.

also to the current flowing in each part. So long as the track and ground conductors are all in direct contact with the soil, the variation of pressure in them will also operate to send currents through the surrounding earth and its buried metallic structures. The difference of the electric pressure existing between the different parts of any electric conductor depends on

SNOW ON ADAMS SQUARE, BOSTON.

Assuming the line to be constructed so that current reaches the rails at a nearly constant pressure above that of the dynamo terminals to which it flows, at the power-house, then the variations in pressure between the rails and the terminals with which they connect at the station as well the difference of pressure between different points in the track system are due to the several resistances between different parts of the track and the station,

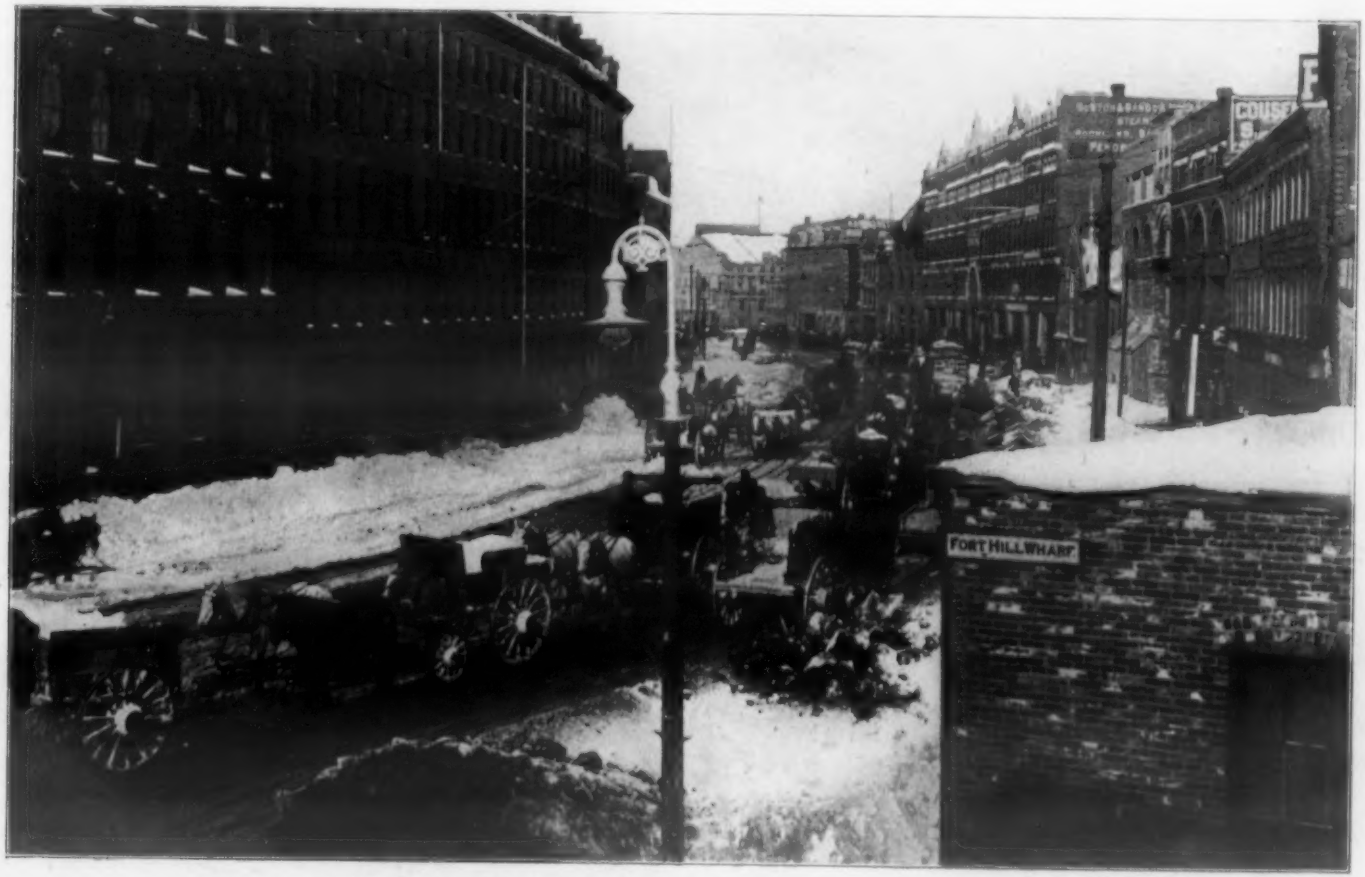
the resistance of the conductor and on the amount of current flowing through it. The electrical resistance of conductors varies directly with their length, so that the greater the extent of track and system of ground return wires, the larger will be the variation of pressure between their parts for a given flow of current or amount of car service. As the pressure existing between different parts of the tracks and ground wires increases

the volume of current diverted from them to the soil grows larger and the damage to buried metallic structures becomes more serious. If both the track and its return wires are to remain in direct contact with the soil the variation of pressure between any of their parts must be reduced greatly below present practice in America, if the safety of underground metal is to be assured.

In American street railways it is not uncommon to find pressures of from 25 to 50 volts between parts of the track circuit and the station connections of the ground cables, and it is possible to find a much greater drop of pressure along tracks in some cases. Ample experience has shown that pressures materially less than those named are sufficient to force dangerous amounts of current through the soil, and any expedients adopted to prevent electrolysis, while such differences of pressure exist at the rails, can hardly be regarded as more than makeshifts. When it is desired to reduce the drop or variation of electric pressure between the parts of a conductor, for a given current flow as measured in amperes, it is necessary to increase the area of cross section, and therefore the weight of the conductor. The reason for the large variation of pressure along street railway tracks, as named above, is found in a desire to save in the cost of construction.

If the loss of pressure along an extended line of track is to be held at a low figure, say 10 volts, a comparatively large amount of copper return wires from the rails to the station must be used, but this expense it is usually wished to avoid. It is not infrequent to find long lines of electric railway track that are not provided with any return wires whatever, but rely entirely on the rails and their bonds as a path for current to the station. In other cases it is customary to provide a copper ground return wire of such dimensions as will keep the loss of power and pressure, from the standpoint of economy and operation at bearable figures, with little or no regard to the probable effect on other structures, of the drop in pressure along the rails and return wires. In a few instances return wires from the rails to the station have been insulated and run in conduits, but for the great number of cases they have been laid directly in the earth.

In England the importance of a small variation of pressure along the return system of rails or conductors in contact with the soil is appreciated and the Board of Trade rules provide that a drop of not more than seven volts may occur between any part of a track system and the station when an uninsulated return either through the rails or by ground wires is used. It may well be doubted whether so small a variation as seven volts along an uninsulated return conductor insures practical safety from damage by electrolysis, but this small loss is certainly far less dangerous than those from four to ten times as great found in the United States. On the extended street railway lines common about our cities it would certainly incur a large expense to limit the variation of pressure along rails and ground return wires to even the English figure of seven volts, but happily there is an easier solution of the problem in the use of insulated return wires from the rails to the power station. If the return wires are insulated the drop or variation of pressure in them may be anything desired so long as the pressure at the points where these wires



SNOW TEAMS ON ATLANTIC AVENUE AT FORT HILL WHARF, BOSTON.

join the rails remain practically uniform. This uniformity of pressure at the rails may be obtained by proper proportion of the return or feeder wires to these various sections.

To make the use of insulated return feeders effective for a nearly constant pressure at the rails, it is necessary that the use of the track as a path for the current from the cars to the station be abandoned. So long as the rails are used as a path for the return of current to the power house the drop or variation of pressure incident to that return must appear along the track, no matter how many insulated feeders are laid to conduct a part of the current. When the track is connected with the station only by properly designed and insulated feeders the pressure variation between the rails at different points in the system will be slight and due to the shifting character of car loads. This small pressure variation between different parts of the track may be still further reduced by the use of ground wires to connect tracks at points where pressure differences are likely to exist. It is obviously impossible to prevent contact between the tracks and the soil, and the only safety from electrolysis, therefore, consists in a nearly uniform pressure for all of the tracks and the location of all drop or variation of pressure in insulated feeders between the rails and the station. These insulated feeders should be carefully proportioned as to their size and resistance in order to insure about the same pressure at the rails near the station as exists on those most distant. Where electric roads run across country districts, where there are no metallic structures underground to be destroyed, the waste of energy by excessive drop of pressure and the destruction of the rails by electrolysis may be matters that concern only the management of the line, but in cities and towns where vast public interests are in jeopardy, there is pressing need of legislative or other action to protect underground metal from railway currents.

NECESSARY QUALITIES FOR PAVING BRICKS.

By Almon D. Thompson, C. E.

It frequently occurs in engineering practice that the problems which appear the simplest are the most difficult of solution. No better example of this truth could be cited in municipal engineering than the matter of specifying the qualities to be possessed by bricks acceptable for paving purposes and the methods necessary to determine the same. At first thought it would appear these qualities are items of common information, while any intelligent person should, according to popular belief, be able to judge by a simple inspection the fitness of a brick for paving.

The fallacy of these propositions has been exposed at great cost through cases of rapidly destroyed pavements.

Engineers and manufacturers interested in this class of paving have for several years realized the necessity of establishing practical and proper standards of quality, with

adequate and certain means for ascertaining the character of the materials submitted for use. If good paving bricks were made from only one material, or by one method, or if it were possible to produce but one grade of pavers, the problem would be much simplified. But the actual trade conditions provide a more seriously complicated state of affairs. Good pavers are made from a variety of materials and methods, and it is an absolute impossibility for the manufacturers to secure from the total output more than a relatively small proportion of the highest grade. It is agreed that the quality must be determined by test conditions of sufficient number and character to expose the defects in material and manufacture. Such specified requirements should also admit an allowable variation from the ideal results desired, and thus come within the limits of manufacturing possibilities. The qualities desired, the tests required to determine these qualities, and the fixing of limits between dangerous and allowable defects, have been causes for a wide diversity of opinion between engineers and manufacturers, and even among men in the same line. These differences as to what is necessary and fair are caused principally by the absence of reliable information, based upon extended, systematic experiments and practical observations:

SNOW DRIFT ON STATE STREET, BOSTON.

A large amount of isolated, haphazard or semi-systematic experimenting has been done by numerous municipalities, societies, technical colleges, individuals and manufacturers which are necessarily limited in character, subject to local conditions and prejudice, and of small value excepting to a par-

ticular locality, since they contribute but little information to the general knowledge of the subject. There has undoubtedly been a rapid advance in the quality of the bricks produced within the past few years, but this has been due mainly to the competitive necessity of the manufacturers rather than the necessity for conforming to general practical, steadily advancing requirements specified by the engineer. By observing the wear in pavements and through experiments upon the individual product, the manufacturers have eradicated many of the defects of earlier paving bricks and much credit is due them for the good thus accomplished. They have even endeavored to assist the engineers by recommending through the national organization certain test requirements based upon the most complete and thorough investigations and experiments available at that time.

The limited field covered by the investigations of municipalities, societies, colleges and individuals has been noted as a bar to the solution of this problem through such efforts. A general settlement of the difficulty through these sources is completely prohibited because it has been clearly proved that these researches must be conducted and the resulting recommendations promulgated by a body of recognized jurisdiction and ability before they will be generally accepted as authoritative by the various interests involved.

It would appear that the ends desired can be best secured through investigations conducted by the United States government under supervision of the proper department and in direct charge of special experts if necessary. The standards for all construction materials used in public works, together with the means for determining the same, should be fixed in a general way by the national government. The necessity for this action with reference to paving brick is particularly pressing because of the rapidly increasing use of the material in city streets and its possibilities in the improvement of country roads which renders the selection of the material a subject of financial interest to a large proportion of the tax-paying population of the country.

This particular work is so closely allied to the good roads movement there would appear to be no valid reason why it should not be undertaken by the good roads division of the department of agriculture. The thoroughness of the research, the direct comparative merits of bricks from all sections, the solution of problems relating to ingredients and details of manufacture, and the weight of governmental approval on the results are desirable and necessary results that can be secured only in this manner.

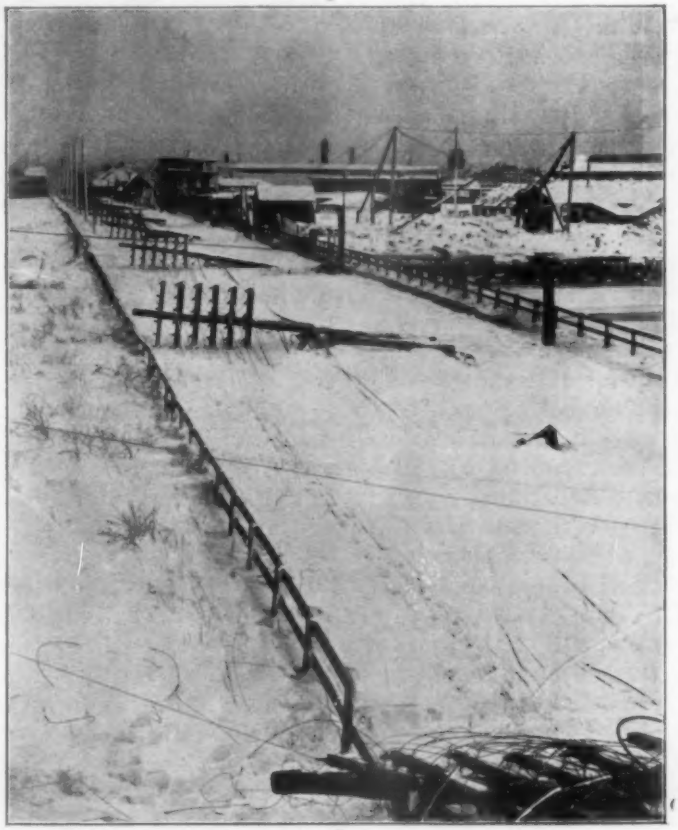
THE PROBLEM OF SEWAGE SLUDGE DISPOSAL.

By W. L. Hedenberg, C. E.

The disposal of sewage sludge, or the solid part of the sewage, after the water has been allowed to run off, is becoming every year a more difficult problem to solve. This applies more especially to towns and cities situated at some distance from the coast. Years ago, when the first settlers were pushing inland, they naturally avoided arid districts, and located, whenever possible, on the banks of some stream. There were

two causes which led to their so doing. The land was found to be more fertile in such localities, and the population had to rely, in those days, almost entirely on water transportation. As the country developed and the population increased, towns and cities gradually sprung up where the settlements had been.

into the stream and at the same time drawing their water supply from the same source, diseases and epidemics began to be prevalent. To remedy this state of affairs and improve the public health, the proper authorities insisted on the sewage and wastes being more or less purified. Thus communities



SWETT STREET, BOSTON, AFTER HEAVY SNOW STORM.

From the beginning all waste matter and refuse was thrown into the neighboring stream, as being the easiest and the quickest method of disposal. There was no apparent harm in so doing while the settlements were small and scattered. When, however, the settlements became good-sized towns or cities, located within a few miles of one another, all discharging their wastes

were obliged to treat the sewage in some way, in order to remove the impurities and to prevent the heavy matter from entering the stream. Mechanical filtration, chemical precipitation, land filtration or some other well-known method was resorted to. But in every case large quantities of sludge were accumulated and had to be disposed of in some unobjectionable way. After

numerous experiments and much thought, four general methods of sludge disposal were found to be practical, namely:

1st. Using the sludge in one form or another as a fertilizer.

2d. Using the sludge to build up low land, being careful, however, to cover each layer of sludge with a layer of earth.

3d. Conveying the sludge by vessels to deep water where it could be dumped.

4th. Burning the sludge in a specially designed furnace.

The selection of a method would depend on the locality, method of treatment and finances available. Where perhaps hundreds of tons of filth are obliged to be dealt with every month, method number two, or filling in, becomes impracticable. Likewise, very few cities are so situated that, finances permitting, they could avail themselves of method number three, or dumping in deep water. The fourth method is exceedingly costly and has almost without exception ultimately been abandoned wherever it has been tried. This leaves apparently but one method available, namely, to use it as a fertilizer. Provided it contains a sufficient number of fertilizing agents which command a market value, the problem is solved, as it could not only be readily disposed of, but would also be a source of steady income to the community.

Commercially, the most valuable fertilizing elements in sludge are nitrogen, phosphorous and potassium. The nitrogen is usually present as carbonate of ammonia, or as organic nitrogen. Phosphorous is present as soluble phosphates of soda and ammonia or as insoluble phosphates of lime.

It has often been claimed that to turn crude sewage directly into a water course is worse than wasting it. For where the current is sluggish, the heavy matter will become deposited, and decomposing, will give forth sulphureted hydrogen gas. In addition to this objectionable way of disposal, a monetary consideration would arise. According to the statement of Messrs. Lawes & Gilbert, two well-known authorities, the amount of nitrogen, phosphoric acid and potash found in the excreta of an adult per year is respectively 12 pounds, 2.63 lbs. and 2.25 lbs. With nitrogen at 19 cents a pound, phosphoric acid at 6 cents and potash at 4.5 cents, the amount of money cast annually into the sea, by the city of New York, assuming an adult population of 2,000,000 inhabitants, would be theoretically $5,078,100. Assuming the above figures are correct, it would seem that an enormous amount of money was yearly wasted in this way.

The objection to the use of sewage sludge as a fertilizer exists in the fact that most sludges contain 80 to 90 per cent. of moisture after the effluent has been drawn off. It then becomes necessary to reduce this amount of moisture, in order to get the material in proper shape for transportation, as few farmers would be willing to accept a sludge as fertilizer under these conditions. With a view to remedying this state of affairs, numerous methods have been suggested and tried with varying results.

At Leeds and Manchester, in England, chemical precipitation was adopted as a method of purification. The sludge is pumped from the settling tanks into vats, where the remaining liquid gradually drains off, leaving the sludge with about 50 or 60 per cent. of moisture.

According to the most reliable

EXTENSION OF RESERVOIR OF MAIN DRAINAGE SYSTEM AT MOON ISLAND, NEAR BOSTON.

statements the separation of the suspended matters of sewage by precipitation and filtration and the production of one ton of dried sewage deposits, apart from the cost of the precipitating agents which are used, entails an expense of about $7.50 for each ton of portable dried sewage manure.

At Leeds and Manchester no market was found in the vicinity for this product, so in order to be rid of it, it was given to neighboring farmers for the carting.

Another objection to sludge as a fertilizer seems to be the fact that it is not concentrated enough, there being too much foreign and fatty matter. There is so little nitrogen, the principal fertilizer, in a ton, that after it has been spread upon the land the plants have difficulty in finding it, while the greater part of the manure gradually works into the soil, without in the least stimulating the growth of vegetation.

An interesting series of experiments were carried on in England, and appeared in the First Report on Sewage of Towns, 1862. A fertilizer was made by allowing sewage to flow through four tons of clay ashes and one quarter of a ton of peat charcoal. This produced at the end of a month, eight tons of manure. Two tons of this manure were spread upon an acre of land whose soil was a stiff clay. The crops raised upon this acre were said to be equivalent to the crops raised upon a similar acre upon which twenty tons of ordinary farm-yard manure had been spread. It was also found by experiment that four hundred pounds of Peruvian guano yielded the same crop as could be raised with two tons of the artificial manure.

With a view of concentrating the fertilizing elements in sludge and preparing it for transportation, a Dutch engineer, by the name of Charles T. Liernur, invented a process which goes by his name.

In the Liernur system the sewage is drawn in a comparatively dry state to a central station through a network of air-tight pipes by means of a steam air-pumping engine. Here the excremental matter has mixed with it about one per cent. of sulphuric acid, to retard decomposition. It is then boiled in a specially designed vacuum chamber.

A thick fluid is produced which is spread over the surface of several highly-heated revolving cylinders. The heat of the latter gradually evaporates the moisture, leaving a thick crust upon the cylinders which is scraped off by a second cylinder with numerous projecting teeth. Thus a powder or "poudrette" is produced which makes an excellent fertilizer. An analysis of the latter shows eight per cent. of phosphoric acid.

It is figured that about 110 lbs. of poudrette can be produced yearly per inhabitant, valued at $1.60. The cost of producing this amount of poudrette, so it is claimed, is about $1.20. This would, therefore, yield an apparent profit of 40 cents yearly per inhabitant.

But as it requires something like 400 pounds of coal per year to evaporate the sewage of one person, to say nothing of other expenses, such as labor, repairs to plant, etc., it is, therefore, rather difficult to see how the profit claimed is arrived at.

This method has been tried in Europe at Amsterdam, Leyden, Prague, and still more recently at Trouville, France, but has scarcely proved a money-making enterprise notwithstanding assertions to the contrary. As regards the system itself, it seems admirably adapted for flat countries, such as Holland,

and proved satisfactory at Amsterdam, although it was only used in one portion of the city. It was a means of keeping the canals to a great extent free from household wastes, and apparently reduced the death rate from twenty-five per thousand in 1869 to about eighteen per thousand in recent years.

smoke. In this case the evaporation was carried on in shallow pans one above the other. The heat from a fire underneath circulated up and around them. All the obnoxious gases developed were thoroughly oxidized by combustion. The temperature was kept at about 170 degrees Fahr. As usual the

COMMONWEALTH AVENUE, BOSTON, AFTER HEAVY SNOW STORM.

An analysis of the poudrette shows 15 per cent. moisture, 50 to 58 per cent. organic matter, and 8 per cent. nitrogen.

At Augsburg a method known as the Podewils process was tried. The ammonia in the excrement was fixed by the addition of sulphuric acid. The mixture was partly evaporated and deodorized by being brought into contact with

amount of fuel required to evaporate such a large percentage of moisture ate up the earnings, and the method failed to realize the profit expected.

An analysis of the poudrette from Podewils process shows nine per cent. of water, sixty per cent. organic matter and eight per cent. of nitrogen.

At Bradford in England, the

heavy matter in the sewage was precipitated by mixing with it milk of lime in subsidence tanks. The sludge produced was very difficult to dry, but had a market value of 50 cents a ton, so it was claimed. However, in a report of a committee of the local government board, it distinctly states that the sludge at Bradford commanded no sale. The theoretical value of this sludge was estimated at about $1.16 a ton. Theoretical calculations, however, are of little value, as the supply and demand entirely governs the price.

Some years ago General Scott's sewage cement process was given a trial at Birmingham. This method consists in burning the sludge taken from the settling tanks in kilns, then grinding it into a powder. The plant erected was of an experimental nature, and only dealt with a small portion of the sludge arrested in the tanks. A moderate quality of cement was produced, but at too great a cost. For this reason the method was not generally adopted.

This same process was also given a trial at Ealing. It made good cement, but could not compete in either quality or price with the usual grade of cements then upon the market.

Bricks have also been manufactured at different times from sewage sludge, but have usually proved to be of an inferior quality, and little or no profit was derived from their sale.

In the United States, as in England, numerous methods of sludge disposal have been tried.

At Worcester, Mass., the sewage is purified by chemical precipitation. The chemicals used are lime and alumina. The solid part of the sewage or sludge amounts to about four tons daily. Being an inland city, the satisfactory disposal of the sludge was a serious problem. When the works were first started, the sludge was thrown in heaps and covered up with soil. This, however, did not prove satisfactory. An attempt was then made to burn the sludge, three different furnaces being tried. Once the fire started, sludge containing fifty per cent. of moisture proved self-consuming. In one case some containing seventy-two per cent. of moisture burned at the rate of 2.2 tons in nine hours. Although this method of disposal proved highly satisfactory, the expense it entailed was excessive, owing chiefly to the labor item. It was therefore abandoned and recourse was had to sludge beds. In 1892 the city hauled the sludge to the land belonging to some farmers, with a view of introducing it. The attempt proved successful, for in 1893 the farmers hauled the sludge themselves, without, however, compensating the city for it.

The method of sewage and sludge disposal, as practiced at South Framingham, Mass., very similar to that employed at Birmingham, England, probably comes as near solving the problem of sludge disposal as any method now in practical operation. The crude sewage is run upon a number of acres of land, the solid portion being harrowed into the soil. Crops were raised, consisting chiefly of corn, cabbages and squashes. A recent sale of cereal amounted to some $36 an acre. Thus the sludge is gotten rid of and proves indirectly a source of profit by enriching the soil.

Products can undoubtedly be obtained from sewage sludge other than cement, fertilizers and brick. Owing to the amount of grease usually present in sludge, soap might be manufactured from it, or

GARBAGE REDUCTION PLANT AT COW-PASTURE, BOSTON.

it might be so manipulated that illuminating gas could be produced.

The necessary plant for extracting the proper elements would be exceedingly costly, and the scheme would in all probability be a failure from a commercial standpoint.

Evidently, therefore, the solution of the problem of sludge disposal, from a financial point of view, is not to be found in its use as a fertilizer, in the manufacture of cement, or in the making of brick. It possibly does lie, however, in its use as a fuel for generating steam. Where a community has an accumulation of sludge daily amounting to several tons, the moisture being reduced by means of a Johnson filter press or otherwise to fifty per cent., if used instead of coal for generating steam for an electric light or power station in the town, there would undoubtedly be a great annual saving. That sludge containing a large amount of moisture is self-consuming was definitely shown by the experiments at Worcester, Mass., and elsewhere. There is no reason, however, why, if such a process was undertaken, the moisture in the sludge could not be reduced to thirty per cent., or even less, if kept in a suitable place. It might even pay to construct a special drying room, properly heated and ventilated.

It is true a cry might be raised in a community against the burning of the sludge owing to the fear of obnoxious odors being liberated, but this sentimental objection could readily be overcome by a complete oxidation of the gases by combustion.

There are a number of furnaces on the market to-day that consume garbage and other refuse without polluting the surrounding atmosphere. A special furnace and boiler might have to be designed, but a saving in fuel the first year ought almost, if not entirely, to cover this expense. To the writer this appears to be the only practical solution of sludge disposal for inland cities where under favorable conditions an actual profit could be derived.

In view of the comparative success of the so-called refuse destructor plants in England, in which garbage of every description is made to generate steam for electric lighting and other purposes, some such method as the above would seem well worthy a careful investigation by municipal authorities in this country who are at a loss as to how to dispose economically of constantly increasing accumulations of sludge.

FAILURES IN ASPHALT PAVEMENTS AND THEIR CAUSES.*

By A. W. Dow, Inspector of Asphalts and Cements, Washington, D. C.

In asphalt work, as in hydraulic cement work, and I might say in all cases where cementing material is in use, the first cry heard, if anything goes wrong, is bad asphalt in this, bad cement in that. Such judgment is invariably passed by the large majority of people, and is a general manifestation of their ignorance or thoughtlessness, and in

*Extracted from the report of Mr. Dow to the Engineer Commissioners of Washington, D. C., as published in the Report of the Operations of the Engineer's Department of the District of Columbia, for the year ending June 30, 1898.

UNLOADING GARBAGE IN BOSTON—OLD AND NEW STYLE CARTS.

some cases prejudice. Take hydraulic cement, for example, as its characteristics are more widely known; how many little things are possible that will produce poor work with the best cements? Improper manipulation, admixture with inferior materials, and improper placing.

The same applies to asphalts, except to a greater degree; for improper handling and admixture with poor material will produce work that will prove absolutely worthless, even though the asphalt be of the finest quality. Of course, it is much easier to spoil a poor asphalt by improper handling than a good one, but I know of cases where an inferior asphalt has made better pavements than one of superior quality, because the former was mixed and laid with greater care. I have recently seen a most remarkable case of this in an asphalt that has been used in the central part of this country. On examining the asphalt it would hardly take an expert to condemn it for paving, and practice has amply justified such a decision, for pavements laid with it have proved most miserable failures, disintegrating and going to pieces in less than a year, with one exception. This one exception is now two years old and looks as good as the day it was laid. It is very evident that the handling and selection of materials was done with such nicety in this case that even with a very poor asphalt a good result was obtained.

In this report I do not intend discussing the effects that different characteristics of an asphalt have on a pavement, but to take the most common practical failures as seen on the street, where an asphalt has been used whose quality has been proven superior by practical use, and point out what defects in the material or construction are responsible.

To those familiar with asphalt work the mode of disintegration can be divided into three classes: First, disintegration by cracking in long single cracks that keep extending with time; second, disintegration by rolling or shoving, the pavement becoming wavy; third, disintegration in patches, where the pavement will wear into a hole which in time will extend through to the base.

First. Disintegration by cracking in long irregular cracks.—It is evident to all who are familiar with asphalt pavements that such cracks are due to the contraction of the asphalt surface from cold. Some few cases have been reported where the hydraulic cement concrete under the pavement has cracked as well as the surface, but I believe such cases to be very rare. These contraction cracks usually start near the gutter and gradually extend across the street. They are also found radiating from iron sewer traps and manholes set in the pavement, which rather indicate that the coefficient of expansion of iron is greater than that of the asphalt mixture. They are often found at the joint between an old and new pavement or at the joint made between one day's work and another.

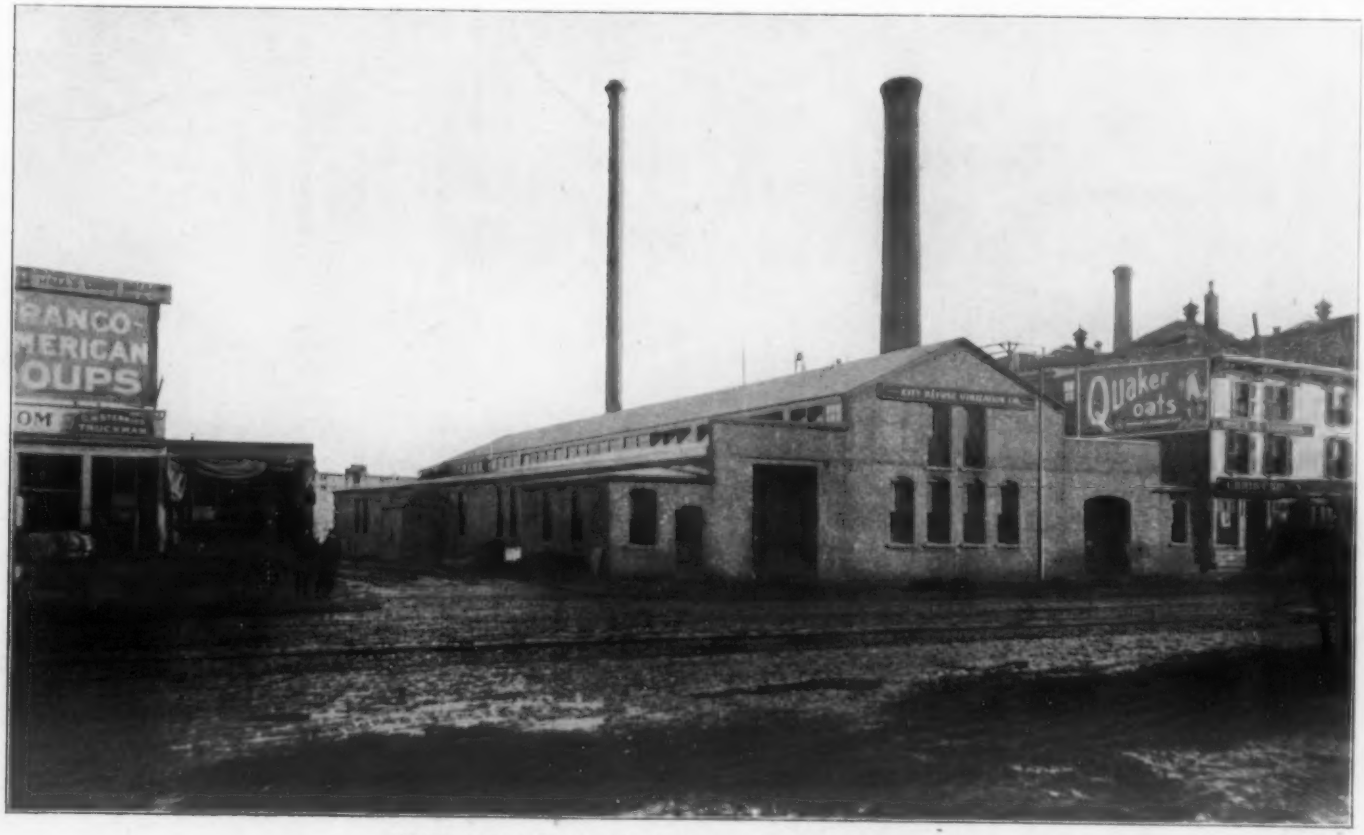
The latter would not occur if the joint had been properly made. These cracks appear sooner and increase more rapidly on a street with but little or no traffic and are seldom found, unless the material has been prepared with very poor judgment, on streets with a good amount of travel. This appears on first thought paradoxical, but it is simply explained. When the pavement is subjected to a continuous traffic the asphalt surface, which is more or less plastic at all tempera-

FARMERS PURCHASING OFFAL IN SOUTH END YARDS, BOSTON.

tures, is kept from cracking by the constant kneading, so to speak, produced by the traffic. And again, when an asphalt surface has but little or no traffic, it becomes more porous owing to the fact that expanding and contracting from heat and cold without the compression due to traffic, it becomes spongy and as a consequence materially weakened. If such cracking occurs at all on a street with a fair amount of traffic, it is evident that the paving mixture used is at fault, either in not being rich enough in bitumen or the asphalt cement used was too hard. As to the proper quantity of asphalt cement to use in a paving mixture to make it sufficiently rich: It is impossible to state any fixed quantity for all cases, as so much depends on the character of the sand. A fine sand will hold more bitumen than a coarse one and an angular one more than a round-grained one. The softness of the asphalt cement also has an influence on the quantity that can be gotten into a mixture. The softer the cement the less of it that can be used. Now as to the relation that the character of the asphalt cement bears to the cracking of a pavement from contraction: It is self-evident that the harder or less plastic the asphalt cement used, the more liable the pavement is to crack. The general rule, therefore, to follow in this matter is to use as soft an asphalt cement as is possible without having the pavement too soft for the conditions to which it will be subjected.

Having now reviewed the causes that lead to the cracking of an asphalt surface, it will be well to look into the conditions that govern the proportioning and the selection of the materials to be used. The conditions that are hardest to meet are where the pavement has little or no traffic on a street running north and south with no shade, and in a climate that has a big range of atmospheric temperature. Such a street will have practically no traffic to prevent it from cracking, as I have explained above, and will be exposed in summer to the hottest rays of the sun, while in winter it will be subjected to the coldest winds. The best asphalt surface mixture to meet these conditions should be made of a sharp sand, well graded from coarse to fine, with the fine predominating. It should have as much asphalt cement as the sand will hold. The asphalt cement should be as soft as is practicable to put in the mixture without having it mark too badly in the hottest weather to which the pavement will be subjected. Let us take this extreme case and modify its different conditions—as, for instance, if the street is narrow and runs east and west, so that it will be shaded by the houses, or if the street is at all shaded so as to protect it more or less from the hot summer sun, the asphalt cement used can be softer, depending on the amount of shade. If the traffic is increased to what might be considered a moderate amount, the asphalt surface mixture just described will do very well from the practical side, but is richer in asphalt cement than necessary, so that it could be changed somewhat for economy. If, however, we keep increasing the traffic and the liability to crack lessens, it will become more and more necessary to alter the mixture to prevent it from rolling and crowding out of shape. The means of preventing this will be treated under the next heading of disintegration.

Some engineers have resorted to the use of expansion joints in the asphalt surface, not to prevent



COMBUSTIBLE WASTE PLANT ON ATLANTIC AVE., BOSTON.

cracking, but, I suppose, to have the pavement crack in geometric figures. I can hardly see the wisdom of such a procedure, for if the pavement is properly constructed it will not crack in several years under the most adverse conditions, and then only at long intervals and generally in some old joint, while if the pavement is improperly made the expansion joint will be but a slight prevention, if any, for irregular cracking. The principle of expansion joints is not applicable to material with no structural strength, like asphalt mixtures. These joints are not only useless, but really detrimental to a pavement, for the asphalt mixture being plastic, there are places that will be widened by the pounding of traffic. And then with asphalts that are rotted by water, they offer crevices in which mud and water will collect which will slowly rot the pavement. The above objections apply equally to all cracks in pavements, so that it is better to construct the asphalt surface in the first place so that it will be less liable to crack than to put cracks in your pavement to prevent others from forming.

Second. Disintegration from rolling or crowding—that is, where the surface of an asphalt pavement appears wavy, or in some cases appears crowded into the gutter. This defect occurs in pavements having too soft a wearing surface, or where there is a defective bond between the base and binder or between the binder and the wearing surface. It is caused by traffic pushing the surface of the pavement up into waves or crowding it toward the gutter. It is a defect that is impossible to entirely guard against on a street with an excess of very heavy traffic, and especially where the traffic is confined to a narrow section of the street. It is, however, inexcusable on streets even with moderately heavy traffic, and when occurring in such cases it will be found due to one of the above causes or to a combination of two or more of them. It is most commonly found due to the defect of making the surface of the hydraulic concrete base under the pavement too smooth, which is the case where gravel concrete is used or where a stone-and-gravel concrete is so rich that its surface is covered with mortar that was brought to the surface by ramming. Unless the binder and surface mixtures are made hard, which makes the pavement liable to crack, they will slide on such a base if there is much traffic. Pavements often roll from a defect in the binder, either because of it being too rich in asphalt cement or because it was dirty when the surface was put on, which prevented a proper union of the two. In some cases where there is a long haul from the paving yard to the street some of the asphalt cement will work down to the bottom of the cart, so that when the binder is dumped it will appear too rich in spots. All these soft, rich places should be cut out, as they are liable to be the cause of the pavement crowding over that spot. A pavement sometimes crowds from the surface mixture being too soft. There are several causes for this: a soft asphalt cement being too rich in bitumen, and being made with a round-grained sand or a sand deficient in fine dust.

A surface mixture, to withstand heavy traffic without rolling, should be constructed with a moderately sharp sand—that is, one whose larger grains are angular yet free from jagged edges, with the grains graded from coarse to fine and having at least 25 per cent. passing an 80-mesh sieve, about 17 per cent.

COLUMBUS AVE., BETWEEN CENTRE AND RITCHIE STS., BOSTON.

of which should pass a 100-mesh sieve. To this sand should be added about 5 per cent. of a fine powder of limestone, 80 per cent., at least, of which should pass a 100-mesh sieve. There should be a moderate quantity of a medium-soft asphalt cement. The quantity and softness of the cement will depend on the character of the sand and the climate in which the pavement is laid.

Crowding from a soft surface mixture is much less frequent than is generally supposed, and the majority of cases where the blame is put to this cause will be found to be partly due to a defective base or binder. I have seen a surface mixture so soft on streets with quite heavy traffic that every wagon left its mark on the pavement on a hot day, yet after three years there was not the sign of a wave in the pavement. Indeed, pavements that mark much in hot weather when recently laid are much more durable than those that mark but little. This is due to the fact that all asphalt cement hardens slowly with age, so that the softer the cement used the longer it will be before it becomes so hard as to be brittle.

The above causes that have been given for the rolling or crowding of a pavement are due to errors in the making of the different parts of the pavement or defects in its laying, but there are other outside conditions which produce this rolling effect, even in perfectly constructed pavements. The rolling in these cases is the first sign of an internal disintegration, and as such cases occur in portions of the pavements while other portions are in perfectly good condition, they will be classed under the next heading.

Third. Disintegration of pavements in spots.—As there are several causes, all foreign to each other, for the disintegration of pavements in spots, it will be impossible to discuss them as a whole, so I will treat each case separately.

When a pavement is laid with a surface mixture deficient in asphalt cement, and the asphalt cement is so hard as to be very brittle in cold weather, the pavement will be ground away by traffic, and as there are always spots weaker than others, the disintegration will naturally take place more rapidly in these places. Such a pavement will disintegrate more rapidly in cold weather, and is also likely to crack badly at the same time.

There are cases of disintegration in spots occasionally met with that are caused by a rolling or softening of the asphalt surface by oils coming from the binder. This occurs most frequently in pavements laid with coal-tar binders, as there appears to be a constituent of some coal tars which is readily absorbed by the surface mixture, softening it greatly, and apparently making it more susceptible to the action of water. Pavements affected this way first give signs of their disintegration by a slight depression over the affected spots. In time numbers of small cracks appear, running parallel with the street. These gradually increase in prominence, accompanied with transverse cracks, until the pavement has the appearance of alligator skin. On examining a section of the surface mixture cut from the affected spot it will be found to be quite soft near the binder, if the disintegration has not proceeded for a length of time; if older, the soft zone will be nearer the surface, while the bottom of the mixture will show the disintegrating effect of the water that has likely entered the pavement through the crack. The affected piece of mixture will smell strongly of coal tar, and will, in all cases,

give a greenish fluorescence to a solution in carbon disulphide. The portion of the pavement thus acted on will be crowded or worn out by traffic until nothing is left of it. If the surface mixture is soft, the pavement will roll at this place, the soft affected material crowding before the traffic. As the use of coal tar in binder was discontinued in this city some time ago, these cases will occur less frequently each year. Binder made with asphalt cement, in some few cases, affects the surface mixture in this way. It is likely caused by the presence of some free oil, which may not have been properly incorporated with the asphalt in making the binder cement.

Disintegration of pavements from the absorption of illuminating gas, escaping from leaky gas pipes or mains under the pavement: There are several streets in the city being ruined by this means, and it appears to be a common thing in all cities having gas. The pavements are affected in very much the same way as when disintegrated by coal-tar binder, except the fine cracks, running parallel with the street, make their appearance some time before the pavement begins to crowd. Pieces of the surface mixture taken up smell very strongly of illuminating gas, and in some cases the gas can be ignited by applying a match to the under surface when it has just been taken up. In nearly every case enough gas will be given off, by heating a small piece of the affected pavement in a tube, to have it flash by igniting.

As it has been doubted by some that this disintegration is really due to illuminating gas, I have made a most thorough investigation of the subject and believe have positively proven that gas is the cause. Samples of pavements were obtained from several affected spots, and in all cases I have been able to obtain from them a gas that exploded by passing an electric spark after mixing with air. The method employed to obtain the gas from samples of the surface mixture was by heating them under boiling water and collecting the gas given off in an inverted funnel. Those not acquainted with the properties of asphalts might suggest that heating any asphalt to this temperature might make it give off a gas. This is impossible, as an asphalt cement such as is used in paving will lose only 3 or 4 per cent., at the most, on being kept at a temperature of 400° F. for thirty hours, and only an infinitesimal part of this loss is a gas at ordinary temperatures. To make a more practical demonstration of this, two samples of a pavement were taken, one from an affected spot and the other from a good portion of the pavement about ten feet away. These samples were treated under boiling water until they ceased to evolve gas. The affected sample gave sevetal times more gas than did the other. On testing, the gas from the good sample was found to consist of oxygen and nitrogen, which was evidenty just the air from the voids of the pavement; the gas from the affected piece gave, on analysis:

	Per cent.
Carbon dioxide	8.4
Oxygen	10 8
Heavy hydrocarbons	13.4
Carbon monoxide	0.7
Hydrogen	6 6
Methene	2.0
Nitrogen	58 1

Having now found that a gas is present in the pavement so affected, let us proceed to examine as to its source. It can not be a natural gas or marsh gas, for there is no analysis of such gases on record that contains appreciable amounts of heavy hydrocarbons, while the gas

from the pavement is rich in these compounds. The same would also apply to sewer air or gas. The only remaining source is illuminating gas, the analysis of which is here given:

	Per cent.
Carbon dioxide	0.2
Oxygen	0.0
Heavy hydrocarbons	12.1
Carbon monoxide	25.5
Hydrogen	39 2
Methene	23.0
Nitrogen	0.0

On comparing the composition of the gas given off from the disintegrating pavement with the illuminating gas, it is seen that they are not at all similar in composition. At first glance it would not seem possible that the former gas could originate from the latter, but when the properties of asphalt are considered it is easily explained.

Heavy hydrocarbons, to which class asphalts belong, are known to absorb other gaseous hydrocarbons; the heavier the gas the more affinity between it and the heavy hydrocarbons. Knowing this, the ingredients of the illuminating gas that asphalt would have the greatest affinity for would be the heavy hydrocarbon gases, a slight affinity for the marsh gas or methene, and no affinity for any of the other ingredients. If we examine the ingredients of the gas from the affected pavement, it will be found to consist of some carbon dioxide, air that was in the voids and cracks of the pavement, and the constituents of illuminating gas with the heavy hydrocarbon gases very much in excess, which is what we would expect. To practically demonstrate that the above takes place when asphalt is in contact with illuminating gas, I took two samples of gas from a tap in the laboratory. One was analyzed, while the other was kept for several weeks in a tube, the interior of which was coated with asphalt cement such as is used in pavements, after which it was analyzed. The results of the two analyses are here given:

	Original gas.	Gas after asphalt absorption.
	Per cent.	Per cent.
Carbon dioxide	0.2	0.1
Oxygen	0.0	0.0
Heavy hydrocarbon	12.1	1 2
Carbon monoxide	25.5	21.8
Hydrogen	39.2	42.2
Methane	23.0	23.2
Nitrogen	0.0	0.6

It is evident from this that the asphalt cement has absorbed over 5 per cent of the heavy hydrocarbon gases, a little methane, and practically nothing else.

I have ascertained by experiment that one part by volume of asphalt cement will absorb forty-two parts of illuminating gas in somewhat over a month. I have also practically shown that asphalt is much softened by absorbing gas, the ordinary asphalt cement becoming as soft as a thick maltha after being in an atmosphere of illuminating gas for several months. As to the quantity of gas contained in the affected pavements, this of course varies, but in one instance 1,000 c. c. of pavement gave off 500 c. c. of gas.

There is but one way to stop the disintegration of a pavement from this cause, and that is to stop the leak of gas; for it is useless to patch the pavement, as it will not be long before the patch disintegrates. I have known of cases where a pavement so affected was repaired and in fourteen months the patches were showing signs of disintegration.

Disintegration by water entering a pavement by oozing up through the base: I believe if more thorough investigation were made into the cause for the disintegrating of

pavement, this would be found to be one of the most common, especially in small towns and cities where there are terraces or considerable lawns in front of houses. There have been a number of cases in this city where the water has entered a terrace or parking where they were above the grade of the street and worked its way up through the concrete base to the asphalt surface.

This disintegration manifests itself differently, depending on the character of the pavement. If the asphalt surface is soft, or the concrete smooth, the first defect noticed will be the tendency of the pavement to crowd in warm weather. This is due to the under portion of the surface mixture rotting, so to speak, thus destroying the cementing properties of the asphalt. The upper portion, although good, being deprived of the support of the affected mixture under it, will be crowded out by traffic. This crowding is assisted by the concrete base being smooth, and also the bond between the base and binder are destroyed by the moisture.

In cases where the concrete base is rough and the surface mixture hard, the principal disintegration will take place in cold weather, nothing abnormal being noticed until the pavement begins a rapid crumbling away in the affected spot under traffic.

On examining a section of asphalt surface disintegrating from this cause, especially where it has not been going on for too long a time, there will be found a layer of perfectly sound and good material at the surface of the pavement, while underneath the mixture will show evidence of being disintegrated by water—that is, the sand will appear clean and white in spots as though there had been an insufficiency of asphalt cement to cover it. The concrete base under the affected pavement will generally be found damp or even wet. We have prevented the destruction of several pavements from this cause by the use of blind drains put in under the gutter next to the lawn or terrace, and even run herring bone under the pavement.

This last cause for disintegration would of course not occur in a pavement constructed with an asphalt that was unacted on by water, but water soaking up through a concrete base might injure any pavement by freezing.

It is always advisable where a pavement shows signs of disintegrating to examine into the cause in a most careful manner and not pass snap judgment. It seems only too easy for the majority of people, whether experienced or not, to place the blame for the failure of a pavement on the manufacturers. I have heard men with considerable experience, commenting on a bad place in a pavement that they had not carefully examined, remark, "they used bad oil or asphalt in that piece of work." They have not taken into consideration that all but possibly a square yard of the pavement is in good condition and that it would be no economy to a contractor to use bad material in one small place of the pavement. A careful examination into the disintegrating of a pavement may, in many cases, show a cause that is entirely foreign to the composition of the materials and a cause that could be easily remedied with a little common sense.

THE BRENTWOOD, N. H., SEWAGE-DISPOSAL WORKS.

The main sewer from the buildings of the Rockingham county poor-farm, at Brentwood, N. H., brings the sewage by gravity, and discharges in a series of tanks, 5 feet wide, altogether 20 feet long, cut up by three 8-inch partitions into four tanks, in which the sewage stands about three feet deep. The amount of water pumped at the farm is 20,000 gallons per day, and presumably most of it finds its way into the sewer. Therefore these septic tanks have a capacity only of holding the sewage from three to four hours. Adjoining this septic tank there are four coarse filter beds, each 16 feet long, 10 feet wide, with the filtering material 3 feet in depth, through which the effluent from the septic tank is discharged at the rate of 1,333,000 gallons per day, if the flow of sewage was uniform. During the time when the sewage is applied to this filter the rate is as high as 2,000,000 gallons per acre daily.

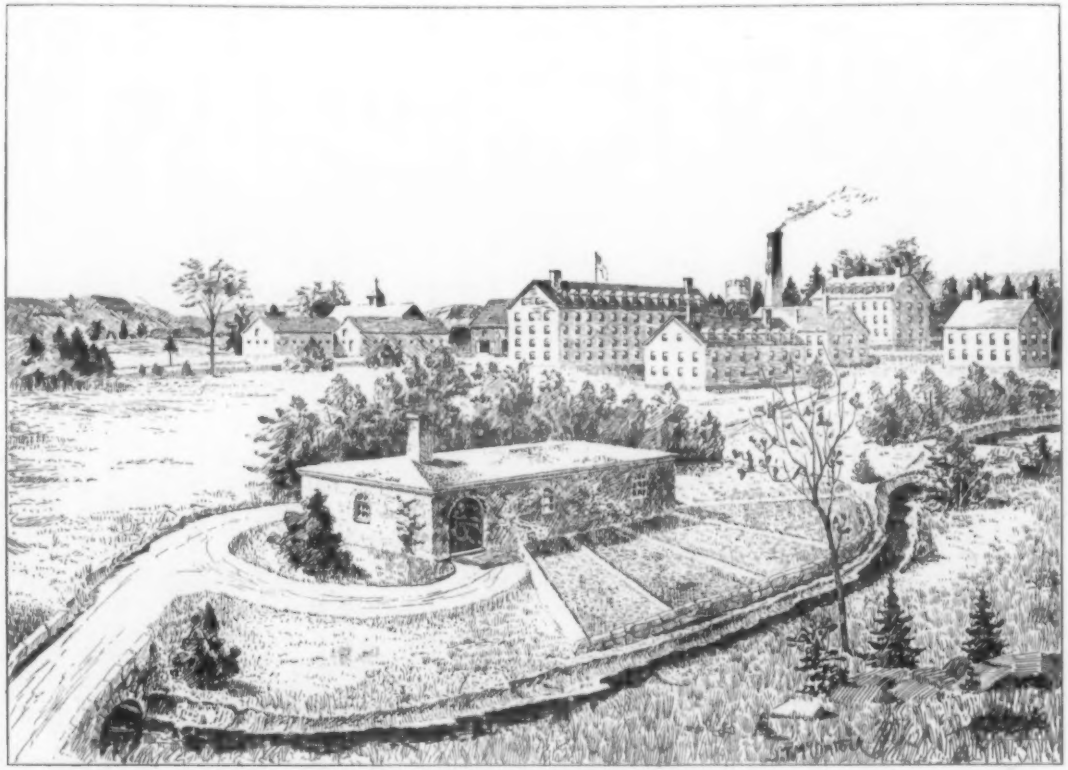
The authorities were directed to provide an additional filter bed in connection with the foregoing, but the effluent received such a degree of purification that they have failed to go to the additional expense involved by the construction of these additional filter beds. Adjoining the septic tanks on the opposite side from the filters, there is situated a small filter bed 10x10 feet, designed to receive the sludge when one of the septic tanks was drawn off. The whole arrangement is covered and enclosed by a neat building constructed of field stone, and is ventilated by a chimney.

This septic tank is too small for the amount of sewage which it receives, but does great service in the liquification of the solids as they pass through it. Mr. John N. McClintock, the engineer who had charge of the construction, says: "From my observations at Brentwood, I am inclined to think that a septic tank large enough to hold the sewage for twelve hours is sufficient. Perhaps one for eight hours would answer. The filter bed, if enlarged about fifty per cent. in connection with the said enlarged septic tank, would purify the effluent sufficiently to allow it to pass into a brook without becoming a serious cause of offense. The outside filter, however, is in every way desirable, and the works are so situated that it could be very readily constructed, and probably will be during the next year."

MIXING CONCRETE AND PLACING IT IN POSITION.

By E. H. Allman.

I can not say that I approve of concrete mixed by hand, as it is seldom ever mixed properly. I prefer mixing by machinery if it can be done. It matters not how small the machinery is, for when it is done this way, it is well done. The trouble when mixing with hand is that it is most all the time done in too great a hurry, and the material is in spots. If it is to be done by hand, the proportion of sand should be placed evenly over the mortar-bin dry, and the proportion of cement spread evenly over the sand; mix the two together



BRENTWOOD SEWAGE DISPOSAL WORKS.

well; after they have been well mixed, spread the whole mass evenly over the mortar-bin and add the proportion of rock or gravel. Then mix the whole together dry.

After the whole has been well mixed, draw the center to the sides, then add enough water to mix thoroughly. If you make the mixture too wet you will cause the concrete to quake when you tamp it. When the concrete is in this condition you do it more harm than good to tamp it; for this reason, when you tamp concrete in this condition you draw the sand to the surface; the cement being the heavier of the two will sink to the bottom, and make streaks of sand through your work. When adding the water decide on the amount you will need, and keep this proportion all through the work. If you keep changing you will always be in trouble; one batch will be too dry and the next too wet. The proportions for concrete should always be measured and not guessed. The concrete should have the appearance of freshly dug earth when properly prepared to be placed in position.

In tamping concrete the tamping should be well done. Tamp well enough to just draw the water to the surface and then stop. All work in concrete should be laid in sections. You will get better results and fewer cracks, for it allows each section to contract, and it is then not so liable to crack. It is not a wise plan to remove the forming too soon from the concrete, because the cold air will strike the sides and make it contract too fast, which will cause cracks.

I have had a great deal of experience in testing natural and imported cement, and in making and placing concrete in position. I have been a close observer of the results obtained from the different conditions of the concrete, and have seen the good and bad results of the management.

The foregoing rules are recommended to any one contemplating mixing and laying concrete. To prove to any one working natural or imported cement that my assertion is correct I give the following examples: Natural cement, 4 ozs. to 1¼ ozs. water; Portland cement, 5 ozs. to 1 oz. of water. Then your briquettes will be a solid mass, free from voids; double the proportion of water to the briquettes and you have them full of voids and resembling a sponge. The latter is the cause of so many concrete walls and floors in buildings leaking—too much water and too much sand in streaks, making a sifter instead of a solid mass.

THE QUESTION DEPARTMENT.

[By Alton D. Adams, M. A. I. E. E., for MUNICIPAL ENGINEERING.]

UNDERGROUND ELECTRIC CONDUITS.

To the Editor of Municipal Engineering:

Some of our councilmen are interested in putting our electric wires underground. Can you give me any information that would help them to a better understanding of the subject, cost and general plans?

Yours truly,
R. B. McKinnon,
City Engineer, York, Pa.

Experience in a large number of places, notably New York, Chicago and Boston, has shown that it is entirely practical to put wires for telephone, telegraph, low- and high-pressure electric light and power service underground. During some years after underground electric work was inaugurated there was much uncertainty as to what constructions would prove reliable and

satisfactory, but practice has now settled on methods of equipment that may fairly be considered standard. The advantages of underground electric construction, as to appearances, is quite generally recognized, but the decrease in dangers to life and property, as well as the greater reliability of service, are not sufficiently appreciated in many cases. Underground electric construction necessarily involves a much greater expense at first than does overhead work, but the reduction in repair and depreciation charges more than offset the increase of annual interest. Methods of underground work, suited to local conditions and to the distribution of the several kinds of electric service, vary so much that no figures of general value can be given as to cost in a particular case until the extent and character of its requirements are known.

When wires are to be put underground the first step is, usually, to provide a complete system of undergound conduits, into which, after completion, the electric conductors or cables can be drawn. The underground conduits are complete in themselves and may be installed at any time and then allowed to stand empty until the electric circuits are wanted.

In the usual forms of underground conduit the object is twofold, to insure for electric cables mechanical protection, and to prevent destruction of the street surface when the wires must be reached for repairs or to connect customers. One class of underground electric construction, much used for low pressure, light and power service, differs radically from the above in that the conduit, consisting of a wrought-iron pipe, is made complete with its electrical conductors, and both are placed in the ground at the same time. This last system is well suited to the special limits within which it is used, but makes cutting of the street surface necessary when repairs or service connections are required, and is not to be considered for general purposes.

The usual forms of conduit for drawing in wires and cables is laid singly or in groups according to the circuit to be accommodated in a particular street. The conduit provides separate ducts or passages for wires, each duct being usually either circular and three inches in diameter or three inches square. At distances of 500 feet along the conduit masonry-lined excavations or manholes are provided beneath the street and all conduits end in them. Manholes are usually large enough for one or more men to stand and work in, and the electric cables are drawn into the ducts at their manhole openings. Manholes are provided with cast-iron covers at the street surface, so as to be entered at any time, and also with sewer connections in some cases. The conduit between manholes is laid on and surrounded by a bed of concrete about six inches thick. It is important to maintain a uniform grade in each line of conduit from one manhole to another, to prevent water-basins and gas-pockets, the first of which occur at low spots and the latter at high points in the conduit line. In some cases air is forced into the conduit system under pressure to prevent the accumulation of gas from adjacent leaky mains.

Four materials have been and continue to be used to a greater or less extent for electric conduits underground. These are wood, iron, burnt clay and cement. Conduits of wood are usually made up of sections

about eight feet long and joined by a tenon and socket. For these sections a stick five inches square is much used and a three-inch round hole is bored through the center from end to end. Oil of tar or other preservative is usually applied to wood conduits. The uncertain life of wood when exposed to moisture is a serious argument against its use for underground conduits and its application to this purpose is limited.

Cast-iron has fairly good lasting qualities underground and has been used to quite an extent in England for electric conduits, but in the United States it is usually regarded as too heavy and expensive for general work, and is used but slightly. Wrought-iron pipes, treated inside and out with asphaltum, have been used to some extent for underground conduits, when imbedded in cement concrete, but their first cost is high and the inside surfaces of the pipes, which are exposed to the air, are quite sure to be eaten by rust.

Another conduit for underground use has a sheet-iron shell lined with cement mortar, and groups of these conduits, like those of the wrought-iron pipe are bedded in cement concrete. The conduits most in favor to-day are those of burnt clay or terra cotta, commonly made in lengths of four feet and with one or four separate ducts in each length of conduit.

Perhaps the greatest objection to be overcome with the terra cotta conduits is the inequalities at joints which must occur about every four feet. Terra cotta conduit, like the other varieties, is properly bedded in concrete. Another kind of conduit that is used to some extent and for which an advantage as to smooth interiors, especially at joints, is claimed is made entirely of cement and sand properly mixed and molded to shape. It now seems probable that terra cotta and cement or concrete conduits will be more used than all others for underground electrical work in the future.

Many small wires, such as are used for telephone work, are usually combined to form a cable and the saving in space is notable, it being possible to provide as many as 200 telephone wires per square inch of cable section. The heavy wires used for electric light and power service are frequently combined in cables to a smaller extent for economy in handling and in duct space. Most underground cables are provided with a continuous sheath of lead outside of the insulation, for the purpose of mechanical protection and to keep the insulation perfectly dry. As the use of paper insulation in place of rubber is rapidly growing the continuity of the lead sheath is of the utmost importance, since paper loses its insulating properties very rapidly when allowed to absorb moisture. The great necessity for smooth conduit interiors exists because the lead sheath of cables is readily cut. Whether the city where underground conduits are to be used shall install, own and rent the conduits, or whether the several concerns who must use them shall make the investment, is a question to be decided for each case.

[By Charles Carroll Brown, M. Am. Soc. C. E., for MUNICIPAL ENGINEERING.]

HOW FINE MACADAM STONE SHOULD BE CRUSHED.

How fine should macadam stone be crushed for street purposes where unscreened stone is used.

G. A. Bienert, Spencer, Ind.

No stone should be larger than about 2½ inches in its largest dimensions. For mending streets already made the maximum size should be somewhat smaller, not over 1½ inches. For making a new street, several times the cost of screening is saved in quality of road-bed, the screenings being used to make the top surface. They are thus removed from the bottom, where they are a detriment, and placed where they can be of material value in making quickly a smooth surface for travel and in binding together the stones at the surface so that they can take the wear properly.

THE CHICAGO FOUNDATION DESCRIBED.

Please give a description of "the Chicago foundation?" *S. E. Corson,*

Boro. Engineer, Norristown, Pa.

Assuming that the foundation for street pavements is referred to, the following abstract of the latest specifications for foundation of brick pavements in Chicago will give the present standard in that city:

Foundation of Portland cement concrete of a uniform thickness of six inches. Specifications require a good Portland cement, 92 per cent. passing through a No. 100 sieve, passing the "boiling test," setting in 45 minutes or more, tensile strength 400 pounds in 7 days neat, 175 pounds for 1 cement to 3 sand, with 15 per cent. increase in 28 days. Sand, clean, dry, ⅛-inch and less size of grains, not more than 30 per cent. voids, weighing 109 pounds per cubic foot. Stone, best quality limestone, clean, between 1½ inches and 1 inch in largest dimension.

Concrete, 1 part cement, 3 parts sand, 7 parts broken stone. Sand and cement mixed dry, water then added and a stiff mortar made, to which stone is immediately added and mixed, with water added as necessary until each particle of stone is covered with mortar. Concrete is deposited in one layer and rammed to true and smooth surface. Sub-grade is kept moist, and concrete is sprinkled as necessary and left exposed for at least seven days.

DIFFERENCES IN WATER PRESSURE.

Our engineer has noticed a peculiar action in the water in our pipes coming from our reservoirs, which we think you can possibly explain to us. For convenience, we will call the reservoirs No. 1 and No. 2. We will give you a table of the pressure on the pipes at the pumping plant, as follows:

	Static.	When pumping.	Dis. Fm plt.
Reservoir No. 1.....	25 lbs	90 lbs. =65 lbs.	1 mile.
Reservoir No. 2.....	80 lbs.	180 lbs. =50 lbs.	1¼ "

Can you explain why the friction seems greater to the reservoir which is nearest the pumping plant? The only obstruction we can think of on the shorter line is a forty-five degree Y. The main is the same size in both cases—eight inches. To reservoir No. 2 is pumped sixty-five strokes to the minute, and in No. 1, seventy strokes to the minute, fourteen gallons per stroke.

Alamitos Water Company,

By Geo. C. Flint, Sec'y, Long Beach, Cal.

The head used in forcing water to Reservoir No. 2 is very nearly the theoretical amount that would be consumed in friction in a new eight-inch pipe with the discharge and length given. If the pipes were each one mile long the difference in head used would then be about 25 pounds. About six pounds of this additional pressure required in the pipe to Reservoir No. 1 can be accounted for by the greater velocity required to deliver the greater quantity pumped. Accord-

ing to the latest estimates, if the pipe to Reservoir No. 1 is about ten years older than the pipe to Reservoir No. 2, the 19 pounds difference in pressure remaining would be accounted for by the deterioration in the older pipe under ordinary circumstances. The Y spoken of probably accounts for much less than five per cent. Differences in methed of entry of pipes into reservoirs should be carefully considered. Collection of air at summits and of sediment at low points in pipe must be eliminated. Considerable head can be used, without special attention being called to it, in producing a fountain-like effect and in producing currents in the reservoir. With all these causes of difference eliminated any remaining loss in pipe No. 1 is probably due to special obstruction or deterioration.

CONSTRUCTION OF CONCRETE ARCHES.

Please inform us regarding following concrete work: We desire to make concrete arches; material to be used is cinder concrete. The iron beams are 15 inches I 7-0 apart. Please advise if you think concrete arches can be turned without fear of falling down between these I beams. How much spring should we have in the centers. We wish also to know if concrete can be put in without putting in expanded metal over the wooden centers.

The Drehmann Paving Co.,
C. E. Drehmann, Philadelphia, Pa.

The adequacy of this construction will depend upon the load to be carried on the arches, whether it is a dead load or a live load, whether slight deflections can be permitted without cracking plastering, character of cement, and workmanship, etc. A definite answer can not be given without detailed information on all these points. The arches will stand if they are used simply as a covering and carry no more than a snow fall. The limit of load with cinder concrete without metal reinforcement is very soon passed even with the best material and workmanship. A competent engineer familiar with the exact data will be the best adviser.

FORMULA FOR STREET GRADES.

In your issue of June, 1899, in the article concerning street grades, you publish the Engineering Record's formula for elevation and distances of summits. In this formula there appear two or three typographical errors, I believe. Kindly give me the correct formula, or the corrections to that part of that article.

John Eaton Shepardson,
Kewanee, Ill.

The formula in question can be easily derived. As stated on page 362, June, 1899, let

A=elevation of the higher street corner.

B=elevation of the lower street corner at the other end of the block.

L=length of curb between them.

S=the slope to be given to the gutters in feet fall per foot of length.

Also let X=the distance from the point A to the point between A and B where the elevation of gutter is highest. Then

$$L-\frac{A-B}{S}=2X \text{ and}$$

$$X=\frac{LS-A-B}{2S}$$

This derived form is that given on page 362, June, 1899.

BOOKS ON SEWERAGE.

Have you an up-to-date book on sanitary sewerage, containing instructions to engineers? I see in MUNICIPAL ENGINEERING a book by H. N. Ogden. Would this be the book for complete work from start to finish on tile sewers?

S. L. Hibbard, Cherryvale, Kan.

Ogden's "Sewer Design" is an excellent book upon its subject. It treats of all the details of design from rainfall to flush tanks; 224 pages. Folwell's "Sewerage" is a larger book ($3) which devotes

about the same space to design and gives in addition over a hundred pages on the supervision of construction. There are many illustrations in both books, and also convenient tables. If you can purchase but one book, the latter will give the best satisfaction. Both books ought to be in the sewer engineer's library.

[By A. D. Thompson, C. E., for MUNICIPAL ENGINEERING.]

CURBS AND GUTTERS FOR BRICK PAVEMENTS.

Kindly advise me through your columns as to the use of so called "park finish" for brick pavements that is, forming gutter with brick and omitting curb. Is it used except for driveways through parks, private grounds, etc.? Would you recommend its use on residence streets in this section? Our streets are only fifty feet total width, that is, the most of them, and we pave twenty-eight to thirty-two feet in width. Our people here talk some of it, but I hardly think it would be wise, under our conditions.

W. A. Doane,
City Engineer, Meadville, Pa.

Regular paving blocks and special blocks manufactured for that purpose are sometimes used as a protection for pavements instead of stone or cement curbing. These blocks are generally short and narrow, so that they do not stand as firmly as stone curbing and they are easily displaced, thus giving a poor alignment after being in use a short time. The principal reason for using such blocks for curbing purposes is because of their cheapness, and their economy depends upon the locality. In certain sections good sandstone, limestone, or even cement curbing, is almost as cheap in first cost, while either is much more stable and presents a much better appearance than the blocks. Some places have also omitted curbing and rounded the brick gutters to serve this purpose. This is not considered first-class construction and should be used only where it is impossible to secure money for providing a proper protection for the pavement and parking.

[By C. W. Tooke, Professor of Public Law, University of Illinois, for MUNICIPAL ENGINEERING.]

RIGHTS OF A PRIVATE CORPORATION TO THE USE OF STREETS.

Former communications to you have been so well answered that I take the liberty of presenting the subject to you upon the rights of a private corporation to the use of streets, alleys, etc., for the continuance of supplying water to the inhabitants of a city after the franchise has expired.

I enclose two sections of a contract relative to this subject and would ask your opinion as to the rights of the party, and the city as well.

Frank Hamilton.
Mayor, Traverse City, Mich.

The sections of contract referred to by Mayor Hamilton are as follows:

Section 1.—Relative to the introduction of water, privileges, term of contract, etc. The said party of the first part, in order to encourage and promote the introduction of water into said city for fire protection, domestic and all other purposes, in manner and form as hereinafter set forth, hath granted and agreed, and by these presents do grant and agree to and with the said party of the second part, that said party shall have the right and privilege, at his own cost and expense, of laying down and maintaining water mains and water pipes in the streets, alleys and public places of said city, for the introduction of water into said city from a point hereinafter mentioned; and for the purposes aforesaid for and during the term of twenty years from and after the date of this agreement. Such grant and privilege, however, to be held and enjoyed subject to the faithful performance by said party of the second part of the covenants, conditions, terms, and limitations in this contract contained.

Section 10.—Relative to the ownership of property, privilege, time and manner of purchase rights of city in case of disagreement. It is further mutually agreed and understood that all the mains, pipes and hydrants laid and placed in said village by the party of the second part, under this contract, shall be and remain his property, unless the party of the first part shall elect, at any time after (15) fifteen years from date, to purchase said water-works with all the rights and privileges, mains,

pipes, hydrants and appurtenances, and the said party of the first part shall have the right and option to purchase the same, and it is mutually agreed upon by the parties hereto, in case of a disagreement between said parties in reference to price, then the price shall be fixed, ascertained and determined by three disinterested parties not re-idents of said city, one to be chosen by the party of the first part, one by the party of the second part, and the third by the ones chosen by the parties hereto, it being understood in said determination, the said arbitrators are not to consider anything but the actual value of said property, and are not to consider the value of the revenue to be derived from the use thereof. The price so fixed by the said arbitrators the party of the second part agrees to take, and the party of the first part to give. If the party of the first part refuse to sell for said price then this agreement is to be considered null and void.

If the contract between the city and the water company is not further limited by statutory provisions subject to which the contract was made, the right of the company to use the streets for the purpose of supplying the inhabitants thereof with water expires at the end of the period for which it is expressly limited. Thereafter the company has no property rights in the use of the streets for this purpose, although the mains and connections still belong to it and it may have a reasonable time to remove the same. If, after notice, the company fails to remove them, the city, through its proper officers, may remove the property, but may not apply the same to its own use without being liable to the company in damages for the conversion of their property.

It must always be borne in mind in any case like the one in question that the terms of the contract are subject to the provisions of the statutes under which the company is organized and the city empowered to contract for the services. For instance, in some states the statutes which empower a city to contract for the construction and operation of a sewer system by a private company for a term of years make it mandatory upon the city at the expiration of the period, in the event of a failure to renew the franchise, to purchase the plant at a price to be determined by methods set forth therein. It may be that such a provision would be a wise one to apply to water-works companies as well, for the business of supplying water to the people of a given locality is a natural or local monopoly, and the economic effect of an attempt at competition is usually a failure. But while the compulsory purchase of the plant by a municipality at the end of a period of the limitation of the grant might be advisable, a company taking a franchise for a definite term of years assumes all the responsibility for the loss of its franchise rights at the termination of the period and must govern itself accordingly. If it attempts to u-e the streets after the termination of its franchise for the purpose of supplying water to the inhabitants of the city, it may be enjoined by a court of competent jurisdiction, and its acts may further be a ground for its dissolution as a corporation in an action brought by the state through the attorney-general or other officer designated by statute.

LEGAL DECISIONS.

[By C. W. Tooke, Professor of Law, University of Illinois, for MUNICIPAL ENGINEERING.]

RIGHT OF CITY TO DISCHARGE SEWAGE INTO RUNNING STREAM.

In the case of the City of Valparaiso v. Hagen, passed down by the supreme court of Indiana, October 25 (54 N. E. R. 1062), the court refused to grant an application for an injunction to restrain the city from discharging its sewage into a natural water-course, though the waters were polluted to the injury of the lower riparian proprietors. The lower court had granted an injunction to the plaintiffs, who were riparian owners and occupants of lands abutting on the creek in question from two to ten miles below the city. The fact showed that not only were the waters polluted so that they were rendered unfit for the use of cattle, but that in flood tide great quantities of filth were cast upon the pasture lands, befouling the grass and endangering the health of the plaintiffs and their families by the miasma arising therefrom. The court in giving its decision reversing that of the lower court lays stress upon the point that the city as a whole is a riparian owner with certain dominant rights and that these rights are different from those of an ordinary owner because the necessities of the city differ from those of an ordinary abutter; that while under similar circumstances, if the discharge of sewage had been by a private citizen, the court might grant the injunction, nevertheless, that a municipal corporation from its nature has superior rights and that the owners of the servient lands must take notice of such superior rights. As though confessing the weakness of this proposition, the court limits the application of the principle in the present case by taking advantage of the fact that the plaintiff failed to aver the absence of skill or the want of due care on the part of the city. While the decision on this technical ground can unquestionably be sustained, we can not doubt that, even in accordance with the language of the court, the circumstances furnish a proper case for the exercise of the powers of a court of equity and that the defendant should be restrained from continuing to thus permanently injure the property and health of the owners and occupiers of the lands lying below the city. It could so easily be shown that the open discharge of the sewage into the creek is not necessary from an engineering point of view and that due diligence would require a reduction of the sewage by the use of a septic tank or by some other method, that we may well be led to expect a reversal of the decision when a similar case is properly presented for the consideration of the court.

RIGHT TO CUT OFF GAS SUPPLY WHEN PAYMENT IS IN ARREAR —LAW OF CANADA.

The House of Lords recently decided an appeal from the supreme court of Canada on a question that is of general interest to all concerned in the rights of gas companies to cut off the supply of gas as a penalty for non-payment of rent (Montreal Gas Company v. Cadieux, Law Times, vol. 81, page 274.) The appellants were a company formed for the purpose of making and supplying gas in Montreal, and the respondent was one of their customers who had two houses, one his residence and the other a tenament, for both of which he took gas from the appellant company. Payments in the one case were made monthly and in the other case quarterly. While in the first case

the payments were made promptly, in the second, owing to a disagreement with the company, Cadieux refused to make certain payments that were in arrears, and the company attempted to enforce payment by ordering the gas turned off at the place of his residence. The respondent thereupon presented a petition to the superior court for lower Canada, praying that a writ of mandamus might issue to compel the appellants to continue to supply the respondents with gas for lighting and heating purposes at his residence. The trial court gave judgment for the plaintiff and ordered the writ to issue, an order which was affirmed by the supreme court of Canada, to which an appeal was taken.

The House of Lords, in reversing this decision, takes the ground that the interpretation of the powers of the company in this respect must depend directly upon the provisions of the statute. The act under which the company was organized provides:

"If any person * * * supplied with gas by the company shall neglect to pay any rate, rent, or charge due to the company at any of the times fixed for the payment thereof, it shall be lawful for the company * * * on giving twenty-four hours' previous notice, to stop the gas from entering the premises, service pipes, or lamps of any such person * * * by cutting off the said service pipe or pipes, or by such other means as the company shall think fit."

"The case," says Sir Henry Strong, "appears to their lordships to be too clear for argument. There is nothing in the act to limit the right of the company to the service pipes of the defaulter in a particular building, or connected with a particular meter, in respect of which the default has been committed. The supply is to the consumer, and the default is the consumer's default. His liability to the company is a liability for the whole of the debt which he owes at the time. * * * Their lordships are unable to see anything unreasonable in the particular instance given, or anything unreasonable in a provision authorizing a gas company to cease supplying a customer who will not pay his gas bills, but the real answer to the argument of the learned judge is, that it is not for the court to pronounce an opinion upon the policy of the legislature. Their only duty is to give effect to the language of the legislature construing it fairly."

LIABILITY OF MUNICIPAL CORPORATIONS ON IMPLIED CONTRACTS.

A valuable article from the pen of Seymour D. Thompson, of the New York Bar, appeared in the October number of the *American Law Review*, on the subject of the liability of municpal corporations as on implied contracts. The general principle is set forth clearly that municipal corporations incur the same liability for their acts, done through their authorized agents and within the scope of their granted powers, as do private corporations or natural persons; and the same implications arise from those acts as in the case of individuals, unless the charter or statute law qualifies this principle. Among the interesting cases cited by the writer in support of this doctrine is that of Argenti *v.* San Francisco, reported in the sixteenth volume of the California reports. In that case proposals were made and bids accepted by the street commissioner of San Francisco, in pursuance of an ordinance authorizing him to do so, for the improvement of certain streets. A contract was entered into with the commissioner, professing to act for the city, and the work was done under contract, measured by the city engineer, certified by him, and warrants were issued therefor. These warrants were not, however, paid because of a lack of funds in the city treasury. It turned out that the street commissioner acted beyond his powers, as he had no right to execute the contract without a further specific ordinance by the city council.

The plaintiff brought his action

against the city, framing his pleading so as to charge the city either upon (*a*) the contract, or (*b*) upon the warrants, or (*c*) upon the ordinance. It was held by the court that, although the contract was informal, the city, having accepted the benefit of what the plaintiff had done in good faith, was estopped to repudiate its liability under the same, and was bound to pay what was justly due thereunder. The view of Justice Cope was to the effect that the action of the city officials amounted to a ratification of the original contract. Mr. Justice Field, while holding that the doctrine of ratification did not apply so as to make the city liable to pay for street improvements, held that there was in the particular case a valid, though informal, contract. This latter view seems to be the correct one, and is affirmed by the supreme court of the United States in the case of Railway Companies v. Keokuk Bridge Co. (131 U. S. 371), in which the following language is used: "According to many recent opinions of this court, a contract made by a corporation, which is unlawful and void because beyond the scope of its corporate powers, does not, by being carried into execution, become lawful and valid, but the proper remedy of the party aggrieved is by disaffirming the contract, and suing to recover, as on a *quantum meruit*, the value of what the defendant has actually received the benefit of."

As an illustration of the application of this doctrine to cases in which services have been furnished to a city, the case of the Port Jervis Water Co. *v.* Port Jervis, reported in 151 N. Y. Reports, is in point. Here the water company contracted with the village for operating a system of water-works therein and for supplying the village with water for fire protection. The company not only supplied the water for this purpose, but, with the knowledge and consent of the village officials, also furnished water for a public fountain, watering troughs, and street sprinkling for the period of three years; and it was held that the law would imply a contract on the part of the village to pay what the water supplied for these purposes was reasonably worth.

So, also, where extra lights have been furnished to a city through a mutual misconstruction of the contract with an electric-lighting company, the courts of Alabama allowed a recovery for the services rendered after the discovery of the mistake and a demand by the company that the city officials designate which lights should be discontinued. (Brush Electric Light Co. *v.* Montgomery, 114 Ala. 433, 447.) A further application of this principle appears in those cases in which companies fail to furnish the full services provided by the terms of their contract. Notwithstanding the failure of the company to carry out the contract in full, the municipal corporation which has received the services in question is liable for what they are reasonably worth, subject to a counter-claim for damages for the breach of the contract. (See U. S. Water-works Co. *v.* Du Bois, 176 Pa. St. 439; Sherman *v.* Coner, 88 Texas 35.)

COMMENT ON CURRENT TOPICS.

Asphalt For Small Cities. The evolution of the portable plant for preparing asphalt mixtures for laying of pavements seems now to be complete. Satisfactory work can be done, and with experienced operators it can be done with little more delay and difficulty than at well-equipped permanent plants, at any rate of speed up to the capacity of the apparatus. This means much more to small cities than is generally supposed. Pavements of this material are now obtainable at reasonable or even low cost by any city having even less than a mile of pavement to lay, and many cities of, say, 50,000 population, or less, which do not feel able to lay pavements enough to warrant the construction of a permanent plant, can now secure what they want at prices even less than those paid by many larger cities.

Recent experience shows some places where the city officers should secure expert advice in preparing plans and contracts, and in supervising construction. Trouble with foundations seems to be quite common. This arises from two or three conditions and is readily obviated if early and good advice is taken. If the local materials are poor, sand and gravel being poor and dirty, and broken stone of poor quality, or hard to get, the contractor is willing to put up with materials less satisfactory than those required by the contract, and incompetent inspection will let them pass, if any inspection is considered necessary. Frequently the preliminary steps necessary to secure the authorization of the pavement are made so late in the season that foundation or asphalt must be laid in inclement weather, or held over until the next season. Contractors cause delays also, by insufficient preparation, by unsuccessful attempts to use poor materials, by taking more work than can be done easily, causing vexatious waits for the arrival and installation of the asphalt plant.

That proper work can be secured by strict adherence to specifications—even those furnished by the contractors—is shown by recent instances. In one case a short pavement was undertaken, and excavations were promptly made. Delays in getting materials put the construction so late that gravel concrete was finally laid, but the gravel was so dirty that the result was unsatisfactory. Property-owners demanded the use of the street, and the asphalt company finally laid the surface in a snow storm. Before spring disintegration had begun, and after much controversy over the question of responsibility for the conditions, the entire pavement, including foundation, was taken out and relaid. In another case, where traffic over the street was very light, similar delays led to the laying of some concrete in freezing weather, and laying of asphalt was postponed until spring. Although covered to some extent, much of the concrete was injured by freezing. The watchful city of-

ficers demanded repair of the injured portions, and finally carried their point, requiring relaying of the concrete before the surface was put on. If attempted deviations from the specifications are always met in this manner, contractors will soon cease trying to save money in this way, since, in case they are met in the manner described, the attempt results in considerable loss.

A very important factor in the value of the pavement is the character of asphalt used. The proprietors of an asphalt which has not yet been used for paving purposes, will be willing to lay such small jobs in places where failures would not be conspicuous, as experiments, to determine the value of the material and the proper method of manipulating it. A long period of guaranty for materials, say ten or fifteen years, is desirable, but is sometimes hard to secure on untried materials.

One note of warning must be sounded, especially for cities so small that only two or three asphalt pavements are probable. Repairs will be expensive after the guaranty period has expired, for experts must be imported, with tools, kettles and materials. Repairs will probably be delayed, therefore, until a large number are necessary, the more rapid deterioration of the pavement where a hole develops being offset by the cost of getting in a repair outfit for small repairs at the proper time. The next place for inventions in the asphalt field is an inexpensive yet efficient repair outfit.

Water Filtration at Albany. The results of the operation of the new filter plant at Albany, N. Y., will be received with interest. The supply has been taken directly from the Hudson river with no change except slight sedimentation and the water has undoubtedly been the source of much disease in the city. The old intake was so located that the sewage of the city itself was brought up stream on flood tides and polluted the water at the intake. Some examinations by the state board of health, about 1892, demonstrated this effect. There is probably no water supply derived from a river at present in use which is subject to such direct and serious fresh sewage pollution as the former Albany supply.

Numerous projects for supplying the city from other sources have been examined and rejected on account of excessive cost, doubtful purity, probable deterioration in quality or other valid reason, and it was finally decided to filter the river water in the most thorough manner possible.

A new intake was located far enough above the city to be reached by the city's own sewage only occasionally and then but slightly. Its location behind a government dike constructed for the improvement of navigation also protects it from direct pollution by sewage from the towns directly above, to a large extent. The largest source of pollu-

tion above the intake, the city of Troy, is on the opposite side of the river, and examinations have shown that the discharges from its sewers tend strongly to remain on that side of the river until well past the location of the new intake. The method of slow sand filtration has been adopted and the plant has now been in operation long enough to indicate that it will work satisfactorily according to the plans provided and in the manner predicted. The full value of the filters can only be determined after actual use under all the conditions occurring and the reports of operation will be of much interest to several cities having similar problems on hand.

The problem at Albany is simpler than at the various cities on the Ohio river which have been experimenting on this and other methods of purification, because the amount of sediment carried by the water is very much less, even in floods, and it is much more readily removed by sedimentation. The problem of construction is therefore simpler, as less capacity is required for sedimentation reservoirs. The problem of operation is simpler because there is far less extremely fine sediment to clog the filters, and cleaning is therefore less expensive and troublesome. If the filters will remove the objectionable bacteria promptly and continuously, there will be much less fear of slightly polluted supplies, and more confidence in the ability to remove the pollution.

Some ingenious combinations of English and German methods of operation and control of filtration processes are in use, which promise to increase the efficiency of the filters.

The Reasons for Bad Roads. In the report of the Indiana Academy of Science, just issued, is a short paper by D. B. Luten, giving the reasons for bad roads, and some suggestions for remedying them.

The first is bad drainage, which, so far as the road surface is concerned, is remedied by keeping the surface crowned. This requires constant attention, especially in wet weather. It should be added that in most soils it is quite as essential to carry the water away from the road in ditches to watercourses.

The second is delayed repairs, remedied again by a man giving the road constant attention.

The third is too much material applied at one time, thus putting the road out of shape, destroying crown and drainage; remedied by employing a man who can give the road constant attention, instead of a visit once or twice a year.

The fourth is too little labor, material usually being cheaper than labor, and considered to be the more valuable the more there is of it; remedied by employing an intelligent man constantly, that he may have time and experience enough to place the right amount of material in the right manner.

The fifth is repairs at wrong season, when farmers have less work,

in supposed preparation for winter, the road being left in shape to be seriously injured by the winter; remedied by constant attention when repairs are needed.

The sixth is improper material; remedied by constant employment of man for repair work, that he may become an expert on the action of the available materials, and know which to use.

The seventh is poor location: This can hardly be remedied as easily as the paper would suggest, being usually an error of the original location on section line, and corrected only at considerable expense for land and damages.

It will be seen that six of the reasons given in the paper call for constant attention as the remedy for the bad roads. In some roads, the man and the materials he can use will develop a good road, but for a prairie country, without materials for road building, a good road must first be constructed and then maintained by constant attention.

Mr. Luten makes the point that those who think that cost of repairs will be saved by constructing good roads are mistaken. Good roads demand constant attention or they will become poor. The failures of road building, and the consequent prejudice against their construction by those knowing of the failures, but with little experience of the good roads, are due to lack of constant attention. Gravel or broken stone roads can not be worked in the ordinary way, but must be repaired by a man in constant employment, that he may learn the best methods and materials for his section.

The first cost of the roads can not be saved out of the repairs. It must be considered as a permanent investment on which a good interest is paid in the shape of reduced cost of hauling, and of ability to get to market at any desired time to take advantage of high prices.

Los Angeles Sewers. The city of Los Angeles has complained loudly of the offensive odors from its sewers, and the engineers have regarded with uneasiness the disintegration of mortar in the outfall sewer. Mr. Rudolph Hering has recently made a report upon the subject after a short examination, in which he recommends more thorough ventilation of the sewers and special movable dams or gates for flushing the larger sewers, the smaller sewers being served by flush tanks. He recommends the same methods of ventilation suggested in our Question Department two or three months ago for San Antonio, namely, perforated manholes and house connections without traps opening above the roofs. The equable temperature of Los Angeles makes ventilation by natural means more difficult than is usual. The current of air under the circumstances suggested would be down through the manhole cover and up through the house soil pipe, with some slight reversals, but can not be depended upon under conditions

at Los Angeles. Thorough and frequent cleansing of the sewers to remove the sewage before it has time for putrefaction is therefore more than ordinarily essential.

The decomposition of mortar in the outfall is attributed to the action of the strong sewer gas found there. On account of the disconnection of the outfall from the rest of the sewer system by the "settling basin," this gas can be cut off entirely from the system as a whole, but special mechanical means of ventilation must be provided in the outfall ventilators leading the wind into some manholes to escape at others lower down are recommended. The character of the chemical action of the foul air upon the mortar is not stated. So uncommon an effect deserves a detailed explanation.

Capital of Public Service Companies.

A few years ago an investigation of the Omaha water-works by the city resulted in a report that the actual cost price of the system as existing, if newly constructed, would be little more than half the capitalization of the company operating the works, the remainder representing the value of the franchise to the original grantees who were able, on account of the large profits of operation, to sell out at an enormous percentage of advance on the original cost to a company which attempted, in the usual manner, among other things, to conceal the immense percentage of profit, even on the basis of the price paid by them, by more than doubling the capitalization as represented by stock and bonds. The street car company of Indianapolis seems to present a similar instance. On a first cost of plant which is estimated at about $4,000,000, it now has a capitalization in outstanding stock and bonds of about $12,000,000, and has authority to increase this very largely.

The donation of the franchise to the first company, and the rapid increase in its value on account of the increase in population of the city, have enabled several promoters to make large fortunes in manipulating the stocks and bonds of the various companies involved, and each reorganization has resulted in a large increase in the paper of the companies to keep pace with the increase in value of the property.

This exploitation of the value of the franchises is the great objectionable feature of the present method of managing the grants of permits to own or operate public service industries. In many cases the franchise was originally donated because the uncertainty of profit prevented its sale at any material price, even division of profits being refused. The country was new and without capital, so that all possible inducements were offered to bring them together. The terms of many such franchises are about to expire, and there is much agitation of the questions of municipal ownership and better municipal control. The former question must

be settled by local considerations. The latter demands prompt action if franchises are to be extended or new ones granted.

The franchise takes its value from the people and increase in value belongs to the people. The corporation to which the franchise is granted is the creature of the state and subject to its control. The logic of the situation, therefore, demands such control of the financial operations of the company as shall limit the capitalization to the actual investment in the material construction and means of operation of the plant, and shall secure to the municipality any surplus of profit over a just compensation for management, a fair interest on the investment, and a fund for retirement of bonds, repairs and renewals. There are several methods for securing these ends, such as control of stock and bond issues, division of gross or net profits in an agreed ratio, with or without supervision of management, etc.

Since the republic was founded there have been objections to placing such powers in the hands of municipal officers, corruption in office being deemed certain. It certainly is probable, for it occurs under present conditions. It is hard to see how the effects of such corruption would be greater under the proposed plan than at present. But now, after a franchise is granted or a change of contract is put through, there is no possibility of modification until the contract term has expired. There is no object, therefore, in making a continued effort to sustain an honest administration in this regard. If, however, the contract is in such terms that thorough and honest investigation is all that is necessary to secure its fulfillment, any community which wants honest administration can secure it on demand and maintain it at pleasure. This advantage would outweigh many disadvantages, if such there be.

What State Boards of Health May Accomplish for the Public.

The boards of health of the various states are established for the purpose of controlling in a general way all matters which affect the health of the public and are generally given full jurisdiction in such affairs. The work is confined ordinarily to a discussion of various diseases, the collection of vital statistics, disposition of garbage, regulation of druggists and other matters of a similar nature that are well enough, but which hardly embrace some of the most important matters affecting the general health and welfare of the citizens. The board of health of Massachusetts is an exception to this general rule and the work of this board illustrates what may be accomplished by a broad, comprehensive appreciation of such duties with the support of the authorities to secure their accomplishment. In addition to the work of the ordinary board the water supplies of the various towns are examined and experiments regarding the methods for the purification of water and sewage have been carried on for

years at an experiment station established at Lawrence. These experiments have furnished most valuable data to engineers and municipalities throughout the United States. The results constitute substantially the only practical information in the United States upon the more recent methods.

The proper disposition of sewage and the securing of a pure water supply are sanitary matters that can not be neglected except to the great detriment of the general health. They must be based upon exact scientific facts and the necessary general knowledge, together with the more specific information required to adjust general principles to particular cases, can be secured only through a long series of carefully conducted experiments. It is evident that such work, affecting the health and lives of all the people, should not properly be undertaken by the individual or the municipality. It plainly rests with the state to undertake a matter of such general importance and the Massachusetts board has been the first to recognize this responsibility and proceed with the work along the broad lines demanded.

It is hardly fair, however, for the remaining states to receive the benefit of these results without effort, particularly as the work is of sufficient magnitude to require continuous investigations of all for years to come. Boards of health in other states should make an earnest effort to secure the authority and funds necessary to follow the example of Massachusetts and assist in the solution of these important sanitary questions.

Union of Water, Gas and Electric Plants.

One of the most notable features of modern engineering, in connection with power development, is the tendency to concentrate the coal consuming and the generating apparatus for large areas at a single point. The economics of fuel and labor that may be attained by the adoption of the smallest practical number of generating units, in a given service, is the main reason for this movement toward power centralization. While much progress has been made along these lines in particular kinds of service, as that of electric light and power from central stations, little has thus far been done to unite at one point plants for the three kinds of service, involving the production of power, with which cities and towns are most concerned, namely, water, gas and electric service. The usual unrelated position of plants for these purposes is well illustrated by the recent report of the bureau of labor statistics of the state of Illinois. From this report it appears that there are in Illinois 57 gas plants, all under private ownership; 197 electric light and power plants under private ownership, and 39 under municipal ownership; and 130 water-works plants under municipal ownership, and 35 owned by private parties. It is quite evident that with the diversity between public and private owner-

ship, in the same places, here presented, little can be done in the way of concentration of the several kinds of equipment. The total number of gas plants being owned by private interests, obviously can not be combined with either the 39 electric light and power plants or with the 130 water-works plants under municipal ownership. Neither is any extended combination possible between electric light and power plants and water-works plants, since most of the former are owned by private interests, while the greater part of the latter are under municipal ownership. The relative merits of public and private ownership are not directly involved in the question of advantage through consolidation of the above kinds of service, but it is desirable in any one city or town under ordinary conditions that the three kinds of service have a common ownership. As a wise regulation of public service in private hands must tend to keep its profits below a certain minimum, the saving incident to a consolidation of the above plants would largely operate to the direct benefit of the general public whether private or municipal ownership is adopted. There seems little doubt, however, that public ownership of all these kinds of service will tend to their consolidation more rapidly than will their administration by private interests.

CURRENT INFORMATION.

Another Ruling on Front Foot Assessments.

Judge Cox of the United States Supreme Court handed down a decision Dec. 18, in the case of James B. Lyons vs. the town of Tonawanda, N. Y., et al., ruling upon the question as to whether or not an assessment made pursuant to a state law, for grading and paving a highway which apportions the entire cost of such improvement upon the abutting land according to the front foot rule, without regard to the size and value of the parcels or the benefits derived, is contrary to the Fifth and Fourteenth amendments to the Constitution of the United States.

The plaintiff was assessed about $10,000 on two lots fronting on Delaware-st., in Tonawanda, N. Y., for pavements laid in 1893. He brought suit in Federal court asking for a decree declaring the state acts requiring the assessment to be made by the front foot rule to be unconstitutional, and for an injunction restraining defendants from collecting the assessment. The defendants filed a demurrer, with which a plea was united. The facts were conceded. The court held for the plaintiff, overruling the demurrer and plea and granting a preliminary injunction. The decision in the constitutional question is in accordance with previous rulings—that taxation of the abuttting property for any substantial excess of such expense over special benefit will, to the extent of such excess, be a taxing of private property for public use without compensation.

Obligations of Railronds in Connection with Street Pavements.

The Indiana Supreme Court rendered a decision recently in the case of Cason vs. city of Lebanon et al., as follows: "(1) The officers of a city have full power by proceeding under the law to determine whether a street shall be improved and the kind of improvement, and the courts cannot control the exercise of this discretionary power by injunction; (2) a contract by which a railroad, in consideration of being permitted to lay its tracks in a street, undertakes to restore the street to good condition, gravel it and keep it in repair, does not bind the company to pay for changing the grading of such street, paving it with brick and laying cement sidewalks, when such improvement is subsequently ordered; (3) the

execution of a void contract with a railroad company by a city relating to collateral matters will not make void a contract and ordinance for the improvement of a street in such city; (4) that a city is indebted beyond the constitutional limit when a street improvement ordered may prevent the contractors from collecting from it pay for paving street and alley crossings, but cannot effect the liability of abutting owners to pay for paving in front of their respective lots; (5) it cannot be presumed that the officers of a city will make an illegal and unauthorized payment out of the city funds."

A Water Company's Power in Determining Charges.

Judge Fitzgerald denied the injunction asked for by R. N. Walton, Dec. 11, restraining the Los Angeles City Water company from cutting off the plaintiff's water supply. The plaintiff conducts a lodging house and has occupied the same premises for ten years. He has received water from the company all that time, having no other means of obtaining water for domestic purposes. He conceived what he believed to be a discrimination on the part of the water company by which he was being charged a much higher rate than was being paid by other citizens. He averred that the company was supplying railroad and express companies, breweries, machine shops and other lodging houses with water at a meter rate of 20 cents per 100 cubic feet, and that during the same time he was being made to pay for water at a monthly rate of $5.61, or an excess by one-half of the meter rate furnished to other people. Walton refused to pay his water rate and demanded that the company put a meter upon his premises, which the company refused to do. He, therefore, put in one at his own expense, and since that time has offered to pay the water company at the regular meter rate. The monthly rate was still demanded and the company threatened to cut off the water supply if the water rate was not paid. Action was brought to have the matter determined upon its merits. The court denied the injunction asked for.

A Town's Water Supply Affected by Flowing Wells.

The water supply of the oil town of Warren, Ind., was cut off in a peculiar manner recently. The Warren Oil company drilled a well a half mile from the place. The rock stratum underlying the town and vicinity dips toward the well, and at a depth of 175 feet the drillers struck a heavy flow of clear cold water, which spouted two feet over the top of the casing and flooded the vicinity. The wells in the town began to fail immediately and before night had become dry.

Excessive Charge for Hydrants.

The Wisconsin Supreme Court handed down a decision Dec. 19, in the suit of the Oconto City Water company against the city of Oconto. The suit is to collect money on a contract for the rental of hydrants and is ordered to be dismissed. The rental of hydrants at $40 a year was held as excessive.

Municipal Ownership Advocated by New York's Comptroller.

Municipal ownership of the entire water front, the system of water works, tunnels to be built for rapid transit and other public franchises, was advocated by Bird S. Coler, City Comptroller of New York, in an address before the City club Dec. 14. He urged the separation of revenue paying public improvements from expenditures for the administration of the city. He is having statistics collected which will show that the new piers and purchases of water front property by the dock department to date have more than paid for themselves. He said the same thing is true of the city's water works; that it would be true of the rapid transit tunnel, and that every franchise still owned by the city should be held for the city's benefit.

Good Management of the Syracuse Water Works.

An examination of the affairs of the Water Board of Syracuse, N. Y., for the ten years of its existence finds every dollar accounted for, and the board's financial status in perfect condition. The water department will be turned over to the charge of the commissioner of public works on the first of January, when the water board will cease to exist under the operation of the new charter. In referring to the change recently a local paper said: "The best that any citizen of Syracuse can hope for is that the affairs of the department may be carried on with the same honesty and efficiency that have characterized the department since the first water board was appointed, and Engineer Hill placed in charge of the details."

Tunnels Preferred Instead of Bridges in New York.

The construction of tunnels instead of bridges is favored by Comptroller Coler of New York City. His engineers have been preparing estimates of the cost of building six tunnels, which they say can be done for

$28,000,000, or just the cost of the two new East river bridges. Comptroller Coler does not believe that bridges will solve the rapid transit problem. Besides, the structures are enormously expensive and begin and end nowhere.

Liability of a Street Railway Company for Paving.

The Indiana Supreme Court reversed the judgment of the Cambria Iron company and others against the Union Trust company of St. Louis Dec. 12. The case in which the decision was rendered was the result of a controversy as to whether the trust company, upon becoming the owner of the Richmond City Railroad by purchase or the foreclosure of a mortgage held by the Trust company, was bound to pay for a pavement between the street railway tracks, which had been laid before the foreclosure sale. The circuit court decided that it was not bound to do so, and the men who furnished the paving brick appealed. In reversing the judgment the supreme court said that all the rights of the railway company rested solely on the franchise ordinance, one of the conditions of which is that the owner should pay for the paving.

Right of a Municipality to Fine a Water Company.

Judge Claypool handed down a decision Dec. 5 in which he holds that the borough of Landsdowne, Pa., has a right to require the Springfield Water company, which supplies the place with water, to take out a permit for opening the streets. In opening a street to repair a broken pipe the water company had failed to do this, for which a borough ordinance imposed a fine of $50. The court held that the borough had the right to charge $6 for the permit, but said the $50 fine for failure to secure the permit was unreasonable and could not be collected.

Law to Prevent Electrolysis in Chicago.

An opinion is being prepared by the law department of Chicago as to the power of the city to force street railway companies to provide their rails with proper connection to prevent leakage of electricity and the subsequent damage to water and other pipes laid below the tracks.

Use of Steam Road Rollers in England.

The county surveyor of Northamptonshire county, England, recently sent out to the various urban district councils in the county questions concerning the use of the steam rollers on the main roads. A schedule of the replies received have been issued. Information was sought on the following points: (1) Whether roller is purchased or hired; (2) whether the annual cost of maintenance is increased by use of roller, and if so, to what extent; (3) the length of time a roller has been in use; (4) satisfaction or otherwise with the results. Out of sixteen rural districts ten replied that they do not use a steam road roller in the maintenance of the main roads in their respective districts.

Of the six rural district councils friendly to the use of the steam roller, one decided at a recent meeting to use the steam roller and to have one on hire for three months with a view to purchase. Another council had just purchased a new steam roller with the intention of using it on the main and district roads during the ensuing season, and the opinion was expressed that the cost of maintenance will be considerably less in the course of five or six years. Of the remaining four councils only one had purchased a roller, the other hiring one when it is needed. At Potterburg it was found that the cost was greater at first, but cheaper after two years, and the results after two years' trial are considered quite satisfactory. The Towcester district found that where the stones are simply rolled in the expense was 1s 4d per ton extra; where the scarifier was used the extra cost per ton was 3s 8½d. The roller was used in the autumn of 1897 and in the spring of the present year, but a division of opinion exists in the council as to the value of the results, and further trial will be required before a decision is arrived at. At Middleton Cheney the roller has been used since September, 1897, with satisfactory results, and has not increased the cost of maintenance. Steam rolling has been in operation in Brackley since 1897, and the surveyor is "certain that, after a few years, steam rolling will reduce the cost, as there will not be so much material required." He adds that satisfaction has been given not only to the council, but also to the traveling public, "as the roads are now made for the traffic and not by it."

Contract Requirements in Public Lighting.

Litigation is threatened between the city of Cleveland O., and the Globe Light and Heat company. The contract with the company calls for a seventy candle power light, and the penalty for failure to meet the conditions of the contract is a forfeiture of 6

per cent. for every candle power under seventy. A test was made June 1 and the candle power was found to be 29.5 per cent., a falling off of 40.5 per cent. At the rate of deduction of 6 per cent. for each deficient candle power the total per cent. deduction would be 243, or nearly three times the amount of the bill. For twelve days in July, the time the contract expired, the ratio of deduction was 178.4. The company's claim for June lighting was $3,076.83 and for July $1,507.95. Under the terms of the contract the company is in debt to the city, but the city officials offered to pay the company half price. The company refused the offer and notified the city to pay up or the lights would be shut off.

Litigation Over Damages to Pavement.

A protest has been entered with the board of public works at St. Paul, Minn., by Emil Geist against his assessment for paving Sixth-st., from Smith to College, in which he charges it is not the common use of the pavements that has ruined them in the past, but that the damage was done by allowing corporations to tear them up. Mr. Geist petitioned for the paving of the street with macadam in 1883. Shortly after it was completed sewer diggers and employes of the gas company and water company began making excavations which they never properly filled. In 1891 the board of public works ordered the laying of a wooden block pavement. This pavement met with the same treatment that the macadam did from the hands of the excavators. About four weeks before Mr. Geist's protest was filed a new sandstone pavement was completed, and workmen from the St. Paul Gas company have already made excavations in it for the purpose of repairing the pipe system.

Suit on a Lighting Contract.

A suit was filed in the United States court Dec. 21 against the city of Indianapolis, Ind., by Judson A. Wann, receiver of the Sun Vapor Street Light company, Canton, O. The receiver, who asks for $10,000 damages for an alleged violation of contract, sets out in his complaint that the Board of Public Works contracted with the company in 1893 to furnish the city with 500 vapor lights, which were to burn on a moonlight schedule. The company furnished 402 of these lights and was to receive $16.50 a year for each light. This contract was to run for five years, and when the receiver was appointed he carried out the contract until Dec. 19, 1894. The board then notified the receiver that the contract was illegal and refused to pay for the lights. The receiver claims that there is now due from the city $7,215.75.

New Plan for Lighting Chicago.

A new plan for lighting the city of Chicago has been devised by Mayor Harrison. He proposes to eliminate from the appropriation bill for 1900 the sum of $117,000 which has been set aside for operating 9,000 gas lamps and to use this amount for the extension of the electric lighting system. This course will be pursued each year until the entire system of gas lighting has been replaced by electric lights.

A Review of Law on Street Improvement Assesments.

Mr. C. O. Tichenor, a Kansas City lawyer, recently submitted a report to the bar association, as a member of a committee appointed to consider possible changes in the city charter relative to street improvement assessments. In reviewing the decisions on the subject and in giving his opinion, Mr. Tichenor said:

When the opinion in the Norwood case was first published I had occasion, briefly, to discuss it, as it was quoted as an authority against me, and, while I denied its applicability, I said that it seemed to me to be correct beyond a doubt, notwithstanding the dissent therefrom by three of the members of the court.

Briefly, the case is this:

A woman owned a tract of land in Norwood, O. The village, by proceedings based upon the right of eminent domain, took a strip of this land for a street. This was all the land which was taken. By the constitution of Ohio the jury cannot, after assessing damages for the taking, as with us, consume them by deducting benefits which the jury may supose the rest of the ground to receive by the proposed improvement. The jury allowed the woman $2,000, and she was paid. The ordinance upon which the proceedings were based provided as follows: "The cost and expense of the condemnation of the property, including the compensation paid to the owners, the cost of the condemnation proceedings, the cost of advertising and all other costs and the interest on bonds issued, if any, should be assessed per front foot upon the property bounding and abutting on that part of Ivanhoe-ave. as condemned." Afterwards the council arbitrarily assessed against her ground which was not taken the sum of $2,218.58 solely because a part had been taken. She had neither a hearing nor a chance to be heard, and such a hearing would have been a farce, because by the terms of the ordinance the ground could not escape the assessment for this amount even if it was not benefited at all. So we observe the woman's land was taken away from her and she was made to pay $218.58 for the privilege of losing it. Inas-

much as her ground alone was taken there could have been no question as to benefits to her land from other ground condemned at the same time. It must also be borne in mind that under these proceedings not only is the owner allowed the value of the ground taken, but also damages, if any, to the rest of the ground by the taking.

It is true, of course, that the assessment of benefits and the taking of the land by virtue of different powers, the former by virtue of the taxing power, while the latter is in the nature of a forced sale to the public. The Ohio constitution was so drawn as to prevent a jury from paying the owner of the land taken with speculative benefits to the rest of the ground owned by him, and one cannot shut his eyes to the fact the ordinance was so drawn in the Norwood case as to invade this feature of the Ohio constitution. The taking of the ground, the payment for the same, and the assessment of benefits on account thereof, were all under and by virtue of one ordinance. The village, by the ordinance, gives the owner the value of her ground taken, for she will get nothing anyway, as it will assess the sum allowed her against the rest of her ground, no matter what that sum may be. If this ordinance is valid, then a city may be given the power arbitrarily to say in advance, in this kind of a case, "we will take your land, allow you nothing for it, and make you pay the costs besides."

It is such a case as this that was passed upon in Norwood vs. Baker. It can be readily seen that such an one is not at all like a case where a sidewalk is built or a street paved in front of a lot, and any language used in the Norwood opinion so general as to apply to the latter kind of a case, is simply an "obiter dictum." No court has expressed itself more strongly on this point than the United States Supreme Court, in Parsons vs. District of Columbia, 170 U. S., 51, where it said: "It is trite to say that general principles announced by courts which are perfectly sound expressions of the law under the facts of a particular case may be wholly inapplicable in another and different case, and there is scarcely any department of the law in which it is easier to collect one body of decisions and contrast them with another in apparent conflict than that which deals with the taxing and police powers."

Since the case of Lockwood vs. St. Louis, 24 Mo., 22, decided in 1856, assessments wholly against the ground directly benefited, to pay for paving streets, building sidewalks, sewers, etc., have been held valid by our Supreme Court. During a period of nearly fifty years they have been attacked again and again by the ablest lawyers of this state, until tax bills, issued as our city issues them, are bought and sold in the market like municipal bonds. Intrenched behind a legal principle so old, and developed with such care and by such skillful workmen, it does seem to me that we would, at least, subject ourselves to criticism if we were stampeded by an "obiter dictum."

The United States Supreme Court may hold our way of assessing taxes for improvements illegal, but I do not think so. The opinions of that court show that it has always been very conservative. It has been slow to disturb the machinery by which a state collects its taxes. It has never been eager to hold state laws unconstitutional, and where it has doubted, it has given the law the benefit of the doubt, and held it valid. It has always treated the decisions of a State Supreme Court with respect and has not been keen to over-rule them. I can see no reason why it should make our decisions on this subject an exception.

In fact, on this very subject the court has emphatically expressed itself in Billingham & Co. vs. New Whatcome, 172, U. S., 320, decided since the Norwood case, where it says: "Before proceedings for the collection of taxes sanctioned by the Supreme Court are stricken down in this court it must clearly appear that some of the fundamental guarantees of right contained in the federal constitution has been invaded."

Again, in Bells & Co. R. R. vs. Pa., 134 U. S., 237, the court said: "We think we are safe in saying that the fourteenth amendment was not intended to compel the state to adopt an iron rule of equal taxation."

The opinion in Norwood vs. Baker states the case by a question. After saying that the matter of benefits could have been settled in the condemnation proceedings, by deducting them from the sum allowed to the owner, had it not been for the Ohio Constitution, the court says: "But does the exclusion of benefits from the estimate of compensation to be made for the property actually taken for public use authorize the public to charge upon abutting property the sum paid for it, together with the entire costs incurred in the condemnation proceedings, irrespective of the question whether the property was benefited by the opening of the street?"

The fifth amendment to the Federal Constitution contains this clause: "Nor be deprived of life, liberty or property without due process of law; nor shall private property be taken for public use without just compensation." This was a limitation upon the powers of the federal government. The fourteenth amendment declares, among other things, "Nor shall any state deprive any person of life, liberty or property without due process of law, nor deny to any person within its jurisdiction the equal protection of the laws." Our State Constitution on this subject goes further than the federal, for it says: "That private property shall not be taken or damaged for public use without just compensation." So that when our Supreme Court passed upon the validity of these assessments, it must have passed upon the constitutional limitations on this subject, and the only protection added by the fourteenth amendment is to give the federal courts jurisdiction in this class of cases, thereby making the United States Supreme Court the final arbiter instead of the Supreme Court of the state.

In the Norwood case the court says: "It has been adjudged that due process of law prescribed by the fourteenth amendment requires compensation to be made or secured to the owner when private property is taken by a state or under its authority, for public use." And the vice of the ordinance passed upon in that case was that it not only did not require compensation to be made, but made compensation impossible. The opinion of the judge of the circuit court in the Norwood case, from which court it

went to the Supreme Court, briefly disposed of the case by saying: "Granting, for the sake of argument, that where property is appropriated for a street, the compensation to the owners and the expense of making the appropriation may be assessed upon the several owners, each bearing his proper share, quite a different question is presented when, as here, a municipality undertakes to appropriate to public use the real estate of a single owner for a public street, and then assess back upon him, not only the compensation awarded for the entire street, but also all expenses of the proceeding. If such a proceeding is not taking for public use without compensation I am at a loss to know what would constitute such a taking. * * * This whole subject was considered by Judge Jackson in Scott vs. City of Toledo (1888), 36 Fed. R. 385.

So, then, there is nothing new in the doctrine laid down in the Norwood case; the novelty consists in applying it to a system of special taxation like ours, which the United States Supreme Court never has done. In Williams vs. Eggleston, 170 U. S. (1897), 311, the court says: "Neither can it be doubted that if the legislature, speaking generally, may create a new taxing district, determine what territory shall belong to such district and what property shall be considered as benefited by a proposed improvement. And in so doing it is not compelled to give notice to the parties resident within the territory, or permit a hearing before itself, one of its committees or any other tribunal, as to the question whether the property so included within the taxing district is in fact benefited."

In Hagar vs. Reclamation district, 111 U. S., 755, the court, speaking of special assessment for building levees, said: "The expense of such works may be charged against parties especially benefited and be made a lien upon the property. All that is required in such cases is that the charges shall be apportioned in some just and reasonable mode, according to benefit received. Absolute equality in imposing them may not be reached; only an approximation to it may be attainable. If no direct and invidious discrimination in favor of certain persons to the prejudice of others be made, it is not a valid objection to the mode pursued that, to some extent inequalities may arise. * * * As we said in Louisiana vs. Pillsbury, 105 U. S., 278, there would often be manifest injustice in subjecting the whole property of any district to taxation for an improvement of a local character. The rule that he who reaps the benefit should bear the burden must in such cases be applied."

In Spencer vs. Merchant, 125 U. S., 355, the court says: "The legislature, in the exercise of its power of taxation, has the right to direct the whole or part of the expense of a public improvement, such as laying out, grading or repairing a street, to be assessed upon the owners of lands benefited thereby, and the determination of the territorial district which should be taxed for a local improvement is within the province of legislative direction." Again, p. 356: "But the legislature has the power to determine, by the statute imposing the tax, what lands which might be benefited by the improvement, are, in fact, benefited; and if it does so, its determination is conclusive upon the owners and the courts, and the owners have no right to be heard upon the question whether the lands are benefited or not, but only upon the validity of the assessment and its apportionment among the different parcels of the class which the legislature has conclusively determined to be benefited."

In Illinois Central Railroad vs. Decatur, 147 U. S., 190, an assessment for grading and paving a streeet in Decatur was made against the right-of-way of a railroad. By its charter the road was exempted from taxation, by reason of its paying to the state a certain part of its gross income. The assessment was held valid. The opinion quotes from the decisions of the Supreme Court of Illinois, which held valid the front foot rule, and announced the doctrine that where a city, with authority by its charter so to do, determined that the improvement in front of a lot should be paid for according to its frontage, that then such action of the city was final, and could "neither be disputed nor disproved."

Parsons vs. District of Columbia, 170 U. S., 45, goes further in upholding benefit assessments than the Missouri Supreme Court has ever gone. Under authority of law the district passed an ordinance laying water mains upon a street, and in it prescribed that each front foot, on both sides of the street, should be assessed at the rate of $1.25, and this, too, when the actual cost to the district was but $1.50 per foot of pipe. The Supreme Court held these assessments valid. The opinion quotes with approval from Dillon on "Municipal Corporations," where it says: "The courts are very generally agreed that the authority to require the property specially benefited to bear the expense of local improvements is a branch of the taxing power, or included within it. * * * Whether the expense of making such improvements shall be paid out of the general treasury or be assessed upon the abutting property or other property specially benefited, and if, in the latter mode, whether the assessment shall be upon all the property found to be benefited, or alone upon the abutters, according to frontage or according to the area of their lots, is, according to the present weight of authority, considered to be a question of legislative expendiency." The court also says "that the power to assess and collect these assessments should not be purely arbitrary and unregulated."

In Hagen vs. Reclamation district, before referred to, a party whose lands were assessed claimed that the constitution had been violated, but the court did not agree with him, saying: "But assessments in California for the purpose of reclaiming overflowed and swamp land can be enforced only by suits, and, of course, to their validity it is essential that notice be given to the taxpayer and opportunity be afforded him to be heard respecting the assessment. In them he may set forth, by way of defense, all his grievances." And on page 709 the court, speaking of the owner having no chance to be heard, upon matters, upon which, if he was heard, could not be changed, says: "Yet there can be no question that the proceeding is due process of law, as there is no inquiry into the weight of evidence or other element of ju-

dicial nature, and nothing could be changed by hearing the taxpayer. No right of his is, therefore, invaded."

With us tax bills are issued which cannot be collected except by suit, and in that suit, as a defense, the owner can show, among other things, that the contract under which the work was done is invalid, that the tax bills are for too large a sum, due to the fact that the contractor has been allowed too much, or that the sum due him has not been properly distributed against the lots benefited as the law directs. The defendant cannot show, it is true, that the front foot rule is unjust or improper, because that is not a judicial, but a legislative question.

As the result of what I have written it is my opinion that we ought not to amend the charter. Even if I was convinced that the United States Supreme Court would hold our system of special taxation bad, I would not be in favor of amending now. Changing a system of special taxation is a serious matter, likely to breed much litigation before the change is submitted to by the property owner. If, and when, it becomes necessary to amend we will need the light of an opinion of that court upon the subject in order to know how to amend.

The Philadelphia Lighting Contract.

An opinion was handed down by Judges McMichael and McCarthy of Common Pleas court, No. 3, Dec. 16, in which they refused the injunction to restrain the city of Philadelphia and the companies forming the Electric Trust from entering into a contract for supplying the public arc electric lights during the coming year. E. G. Potts sued as a citizen and tax-payer, alleging that in reply to the customary advertisements the director of public safety had received bids for the electric lighting from the defendant companies, and in spite of the fact that the Kensington company's bid was the lowest, he had awarded the Brush Electric company which had made a blanket bid for lighting the entire city. In refusing the injunction the court reviewed the well-known principle at law, that the duties of city officials are not merely confined to learning who is the lowest bidder in a contract, but also calls for the use of discretion, and the courts will not interfere with this function unless in case of collusion or fraud. The court could find no fraud or collusion on the part of the officers of the municipality, and, in the absence thereof, could not interfere with the discretion vested in the mayor as to the execution of the contract.

Decisions Affecting Water Companies.

Opinions handed down by the Court of Appeals, Dec. 5, declared that the establishment of a public water system in the village of Skaneateles, N. Y., was legal and did not in any way infringe on the rights of the Skaneateles Water company, a corporation furnishing water in that village under a franchise granted it by the duly vested authorities. The proceedings were brought in two actions, and end litigation that has been in the courts for three years.

A decision was rendered by the court of appeals Dec. 5 in the case of the Warsaw Water Works company against the village of Warsaw, N. Y. The decision affirms that of Justice Laughlin and of the appellate division in favor of the village, but the judgment of the lower courts is modified as to the right of the village to impose a discriminating tax upon those who do not use the village water. The old water works company contended that the village had no right to build or maintain a water works system to be operated by it without first buying or condemning the works of the existing corporation, and incidentally that the village authorities had no right to impose a tax, under the statute, for fire protection upon those who did not take water from the village works, but that such tax should be uniform. The decision affects many other villages in New York and other states.

A Ruling on Front Foot Assessment in Indiana.

Judge Baker of the Federal court, in a decision Dec. 2, held that the statutes of the State of Indiana, which provide for an assessment of benefits for public improvements by the front foot, are unconstitutional. The decision was in the case of James Charles vs. the City of Marion. Judge Baker said:

"It is elementary that the constitution authorizing the assessment and levy of taxes is not self-executing. It must be carried into execution by appropriate legislation, and no taxing officer or taxing body can make a valid assessment unless they pursue with reasonable strictness the precise method prescribed by the statute of the state. There is no provision of the statute of this state called to the attention of the court which points out the method or confers authority upon the common council to hear and determine the question of actual benefits received by the property of the land owner by the construction of a public improvement.

"It is not sufficient to constitute due process of law that the statute provides for a notice and hearing. It is essential to due process of law that there should not only be notice of a time and place for a hearing, but, more important, that there should be a tribunal clothed with power by methods prescribed by law to hear and determine the question involved.

"In my opinion there is no provision of the statute that provides a tribunal and clothes it with power and points out the method of its procedure for the purpose of

ascertaining and determining the benefits received by the property of a land-owner by the construction of a public improvement.

"It may be that the Supreme Court of this state will, by judicial construction, import into the statute which authorizes the alteration and correction of the estimate of the engineer a power in the common council, or in a committee of that body, to hear evidence and determine for itself the amount of actual benefits received by the land-owner by the construction of a public improvement, but such judicial construction, it seems to me, would clearly fall within the principle of judicial legislation.

"It is not necessary, however, on the present application for a temporary restraining order that the court should pronounce a definitive judgment on the foregoing questions. In order to justify the granting of a temporary restraining order it is sufficient if the plaintiff shows the existence of a probable right with a threatened injury to that right by the defendant, and that the granting of a temporary restraining order would be less injurious to the defendant than the refusal to grant it would be to the plaintiff. For these reasons a temporary restraining order will be granted until the final hearing of the cause."

The Circuit Courts at Logansport, Anderson, Marion and Shelbyville have each held the law to be constitutional. An elaborate brief was filed Dec. 15, in the case in which Judge Baker rendered an opinion, supporting the contention that the Barrett law is unconstitutional.

A Report on Tests of Mechanical Filters.

In last July the water commissioners of Norfolk, Va., employed Dr. J. J. McCormack to make such tests as were necessary to determine whether the terms of the contract made by the New York Filter Manufacturing company, as to guarantees of color and bacteriological efficiency of water, had been complied with. Dr. McCormack recently completed his thirty-day test of the filter plant and in his report says:

This test was to determine:

1. The reduction of color, which it was guaranteed would be 90 per cent.

2. The reduction of albuminoid ammonia in suspension, which it was guaranteed would be 90 per cent.

3. The reduction of bacteria, the guarantee being that if there were 7,000 bacteria in the raw water to the cubic centimetre, they would be reduced 97 per cent. If there were less than 7,000 bacteria per cubic centimeter in the raw water, there would be less than 100 per cubic centimeter in the filtered water.

The samples of raw water were taken at a point about twenty-five feet from where the water enters the reservoir for collection. The samples of the filtered water were taken from the flume at the north end of the filter plant, where the water flows into the brick reservoir to be pumped to the city.

The average reduction in color of the filtered water was 93.6 per cent. The only time that it fell below 90 per cent. was on Oct. 16, when it registered 85 per cent. This was due to the sulphate of alumina being reduced to 1½ grains per gallon. I should state here that this plant was constructed to filter the Lake Smith and Lake Lawson waters, as it was the most sanguine expectation of your department that it would be two years before the Little Creek water could be used. Upon the completion of the filter plant the Little Creek water was found by analysis to be available, so the guarantee test was made upon this water. The color of the Little Creek water by the platinum-cobalt standard is 99, the color of the Lake Smith water by the same standard is 30, and as the quantity of sulphate alumina requisite is directly proportional to the intensity of the color, we have 99:30::2½x¾.

In other words, if the test had been made on Lake Smith water only three-quarters of a grain per gallon would have been necessary. I am informed by your superintendent that the Lake Smith water was originally the color of the Litttle creek water, and took two years to attain its present color. The same rule should apply to the Little creek water. The method of determining albuminoid ammonia in suspension being arbitrary, I determined the total albuminoid ammonia in the raw and filtered waters and found an average reduction of 94.1 per cent., which is remarkably satisfactory. The average number of bacteria per cubic centimeter in the raw water was 356, in the filtered water 12, giving a reduction of 95.99 per cent. The cultures were made in gelatine bouillon of 15 acidity. This medium, according to the best authorities, gives the maximum growth. The great increase in bacteria on Nov. 1 and 2 was due to a heavy rainstorm. The raw water on those days was very turbid. You will observe:

1. That the guaranteed reduction in color of 90 per cent. has been exceeded, as the average reduction was 93.6 per cent., and this in spite of the fact that the test was made on a water over three times as highly colored as the one upon which the test was intended to be made.

2. That the guaranteed reduction of albuminoid ammonia of 90 per cent. has been exceeded, as the test shows 94.1 per cent. reduction.

3. That there was an average of 356 bacteria to the cubic centimeter in the raw water; therefore, the guarantee is that there shall be less than 100 per cubic centimeter in the filtered water. The average number per cubic centimeters in the filtered water was 12, greatly exceeding the guarantee.

Municipal Reports.

Report of the Operations of the Engineer's Department of the District of Columbia for the Year Ending June 30, 1899.

This department operating under the direction of the District Commissioners has charge of about the same affairs for the national capital as the board of public works in the other cities of the United States. The department being under the direction of an

army officer, not the least detail is influenced by politics, thus forming an ideal arrangement for the control of public works. The reports are therefore of particlar interest to municipal engineers and city officials. Capt. Lansing H. Beach, the Engineer Commissioner, is known as an indefatigable and painstaking official and this report is replete with information and experimental data concisely and clearly stated of great value to the engineering profession.

Sheet asphalt and asphalt blocks were the only pavements laid during the year. There are now 117.67 miles of the former and 15.68 miles of the latter in the District. The prices paid during the year were $1.75 per sq. yd. for sheet asphalt and $1.78 per sq. yd. for asphalt blocks, while the prices for the coming year will be $1.78 to $1.80 per sq. yd. and $1.77 per sq. yd for the two pavements respectively.

There is an increasing objection throughout the city to granite block pavements and the replacing of this pavement with a smoother and less noisy pavement is requested. Brick gutters have been used with asphalt pavements and their continuation is recommended.

"The use of brick gutters for sheet asphalt pavements has been continued, and the experience of the office leads to the conclusion that this form of construction is decidedly better than laying asphalt to the curb. The first gutters of this material were laid with the brick toothed into the asphalt. This practice, however, was discontinued, and the gutters have been laid since with continuous joints. The latter construction has been found to be much better than the toothed method, as it has been demonstrated by several years' experience that it is impossible to sufficiently compact the asphalt between the teeth to prevent water entering, thus producing early decay or breaking up of the asphalt. With continuous joints it is possible to run the roller up to and along the very edge of the brick, producing as much compaction at this point as on other portions of the street. It has been observed in the cases of gutters of the two classes laid about the same time that in the toothed gutter, the asphalt between the teeth and immediately adjacent thereto is, in a number of cases, already beginning to show signs of breaking up, while the asphalt adjacent to the continuous joint gutter is apparently as good as ever."

During the year thirteen of the street railways of the city, which includes all the lines excepting two, were consolidated under one management and free transfers are now given at all connecting points of these various lines. Two lines were equipped with the underground electric system and permits taken out for thus equipping five other roads. The rails used and the manner of repairing on asphalt streets is explained as follows:

"On the streets 8-inch grooved rails have been used, it having been found by experience that rails of this depth give much greater stiffness and consequently less disturbance of the paving, requiring less repairs to the roadbed, a matter which becomes of great economic importance where the streets are provided with an expensive pavement. On streets provided with sheet-asphalt pavement the companies have laid either vitrified or scoria block immediately adjacent to the rails, a double row being laid longitudinally outside of the rails and a single row longitudinally inside of each rail. This construction has given much better results than the former method of laying the asphalt up to the rails."

Provision is made in all new construction for the return of the electric current, as considerable damage was experienced under the old single trolley system from the failure to properly care for this current.

"The construction adopted by the consolidated companies upon all roads where the lines have been reconstructed provides for a metallic return of the electric current. The system used within the city is identical with that previously in use on the Metropolitan and Capital Traction line, and where the roads are operated outside of the city by the overhead trolley the cars have been provided with a double trolley, the return wire being similar in situation and capacity to the feed wires. Most of the recent charters granted by congress which have permitted the trolley to be used have required the double trolley, with feed wires and return wires situated as above indicated, and with the further proviso that no pole of any dynamo furnishing power to the road shall be in any manner connected with the earth."

Considerable difficulty has been experienced in securing sufficient water and it was found that a large portion of the water pumped was wasted.

"It has been found that the consumption of water between midnight and 4 a. m. is practically two-thirds of what it is during the day time, and as the amount consumed during these hours can almost entirely be charged to waste it is fair to consider that two-thirds of the amount used during the day is also waste, which would make at least three-fourths of the total consumption pure wastage. The trouble becomes much more accentuated during extremes of cold and warm weather. During warm weather the water is permitted to run for the purpose of having it somewhat cooler for drinking purposes, and in cold weather it is permitted to run to prevent freezing of pipes."

Every means was employed to stop this wastefulness but the establishment of meters is recommended as the only check upon willful waste. A house to house inspection afforded but temporary relief.

The city of Washington has its own nursery where trees are grown for supplying shade trees for the streets. All trees on the streets are selected, planted, and cared for by the authorities. The report of

Mr. Wm. P. Richards, assistant engineer, states there are 78,000 trees, consisting of thirty varieties, on the streets of the city. If placed thirty feet apart they would line both sides of a boulevard between Washington and New York. Mr. Richards recommends the silver maple, Norway maple and red oak as the best trees for street purposes.

The report of Mr. A. W. Dow, inspector of asphalts and cements, contains a number of tables giving the results of chemical and physical tests of a large variety of cements and analysis of water; 9,119 experiments were conducted. Engineers and contractors who have used considerable quantities of natural and Portland cement have frequently noticed abnormal action and apparently inexplicable peculiarities in different lots of the same shipments of these materials. Mr. Dow began investigations the past year to determine the causes for such irregularities. Both physical and chemical tests were conducted and the results of his experiments thus far are summarized as follows:

"The great strength obtained by some samples of Portland cement, that is, a certain brand of Portland cement that will be running quite uniformly, say, seven-day neat, will average 600 pounds, and the seven-day, one of cement to three of sand, will be averaging 250 pounds, when we will receive a carload that will pull over 1,000 pounds, seven-day neat, and the sand briquette pull over 500 pounds. Our data from the investigation of this point is very meager as yet. We have determined that such cements do not show any weakening with age and appear sound in every respect. On chemical analysis they were found to run from 1 to 2 per cent. higher in lime than the average of that brand, while in all other respects about the same. They differ so little in the ordinary chemical analysis (i. e., in the per cent. of silica, iron, alumina, lime and sulphur) from normal cement, that it is very evident their abnormal strength is due not to the quantity of the ingredients, but as to how they are combined."

"Second. A shipment of natural cement is received at times that, in testing, passes the requirements of the one-day test, but after being in water for a few days the pats and briquets, both sand and neat, begin swelling and cracking. This disintegration generally commences in the fourth day, and in some cases a little earlier. It has never been known to appear after the fifth day."

"Third. Some natural cements, showing nothing normal when tested in the laboratory at the usual temperature, are very much retarded by cool weather in their strengthening in practical work, much more so than cement of the same, as well as other brands. Such cements were found to be lower in lime and higher in silica than normal cements.

"Fourth. We have found some natural cements which will give greater strength at seven days when mixed with two parts sand than when made up neat for the same time. The results, so far, are insufficient to comment on, but we are in hopes of ascertaining the definite reason for the cement testing, as stated.

"More thorough and systematic work will be done on these problems in the future than in the past, and I am in hopes that a study of them will add to our present limited knowledge of cements in general, and especially the natural, or what we might call the dicalcic silicate cements."

Mr. Dow has also submitted a thorough report upon the failures in asphalt pavements and their causes which is of such obvious value to engineers that it is reproduced in full in another portion of this issue.

Mr. W. A. McFarland, Supt. Water Dept., strongly advocates the use of meters to prevent wilfull waste of water by the consumers as the present inadequate supply is due largely to the enormous and unnecessary waste. The plan proposed was for the department to place and maintain meters at its own expense and to charge a minimum rate of $3 per annum for 100,000 gallons with 3 cents per 1,000 gallons for all water above that amount.

Report of the Massachusetts State Board of Health for 1898.

This board has, during the past ten years, furnished more practical information regarding sewage and water purification than all other agencies in the United States combined, and their annual reports containing the results of exepriments along these lines are eagerly sought by sanitary and municipal engineers. The last report contains the usual data on water supply, including the details of chemical and microscopical examinations of the water supplied to the various cities and towns throughout the state, with advices regarding same, statistics of water consumption, rainfall and flow in streams. At the close of 1898 there were thirty-two cities and 321 towns in the state. All of the cities and 130 towns have public water supplies. Although there is only 45.9 per cent. of all the cities and towns having public water supplies, these places include 90.3 per cent. of the entire population of the state. All of the thirty-two cities own their own water works. Of the 130 towns having public water works, eighty-two, with a population of 406,570, own their works, while forty-eight, with a population of 210,590, are supplied by private companies. The average daily consumption of water per inhabitant ranges from 6 to 111 gallons. The year was one of extraordinary rainfall, as there was 9.34 inches more than the normal.

The experiments upon the purification of

sewage and water were continued at the Lawrence experiment station and the results give much information of interest. Experiments were conducted with the septic tank system, and the conclusions on this method are interesting. The studies indicated that a much smaller septic tank can probably be used in proportion to the amount of sewage than has been proposed in Europe. The commonly accepted theory that the tank must include light and air is thought to be erroneous, as experiments seemed to show that the action goes on as well in the presence of air and light as it does without them. The air-tight tanks might be perferable in some instances to prevent the escape of gas until just before the sewage goes upon the filters.

Numerous complaints were received from different places of lead poisoning from water, and investigations have been conducted for two years to learn the nature and degree of the action of the waters of the various supplies upon lead, tin and zinc, with especial reference to lead service pipes. It was found that many waters when brought in contact with lead services, dissolve lead from the pipe and become dangerour for drinking purposes. The report of the chemist, Mr. H. W. Clark, gives full details of the methods used in the experiments and the results obtained.

Annual Report of the Street Department of the City of Boston for the year 1898. Benjamin W. Wells, Superintendent of Streets.

The form of official reports for the city of Boston was definitely determined many years ago, and all are therefore much alike in style. It is needless to add that they are model municipal reports. The resume of the year's work shows that it embraced expenditures amounting to $2,413,728, of which $725,000 was for paving, $500,000 for sanitary work, $350,000 for sewer work, $315,000 for street cleaning and $138,728 for street watering. "In the past eight years," the report says, "Boston has undergone many and great changes, and along lines of broad and progressive development. This work, although costly, has built the foundation for the most desirable city for business or residence in this country. What has been accomplished, had the work been undertaken a few years later, would in part have been impossible, and in every way would have been vastly more expensive." The work accomplished or put under way during these eight years embraced the abolishing of the railroad grade crossings, the building of the subway, the completion of the great Southern Terminal station, the development in part of the vast new dock system, the improvement of park system, the perfecting of the water supply and the extensive work the harbor, the building up of the of the street department, which, in the last three years has been the greatest in its history in amount and importance, embracing five great boulevards, which, branching out in different directions, have brought the outlying sections of the city into close touch with the city proper over well built roads, supplied with sewer, water and gas, so that great areas of desirable residential land are now available for the rapidly growing city. In addition to the boulevards a great number of streets have been built. In the downtown sections many of the most important thoroughfares have been repaved.

The sewer system has been perfected and it is now claimed that there is no other city in the country where the sewer system is so complete or the difficulties to be overcome in the future so few. In the matter of their removal of offal or other refuse the methods of half a century ago were pursued, but all this has been changed and it is claimed that the system now in use surpasses in its sanitary completeness and general arrangement that of any city in the country.

It is stated that the only division not keeping pace, owing to lack of appropriations, with the general work of the department and the growth of the city has been the bridge department.

The old scheme of street watering has been changed so that now every public street is watered by the department and the cost assessed on the abutters instead of following the old haphazard way of doing the work by private subscription.

One of the unsatisfactory conditions that has been overcome is the improvement of the alleys. These in many instances were private property, but under a new law of the legislature they were brought under the control of the street department for paving and cleaning at the expense of abutting owners. A vast amount of this kind of work has been done.

Notably efficient work was done in the removal of snow from the streets and alleys, a total of 123,191 loads having been removed from the streets to the dumps at a total cost of $108,249.

A very interesting review is given of the legislation and work through which the improvement of the sewer system of Boston has been brought about. An important feature of the plan is the system of as-

sessment put into operation. This is divided into two parts, one for maintenance and operation and the other for construction. For the first, one-quarter of the amount is assessed on the basis of land valuation for the reason that all land derives some benefit from sewerage through the maintenance of sewers, water courses and catch basins, which care for the surface water from the streets, and also for the benefits they receive from the use of public buildings, which are exempt from assessment. The remaining three-quarters is based on the water tax, and it has been found that the proportion which this assessment should have to the water tax is about 1 to 5. There are something over thirty classes of water districts. An allowance is made in each special class for such amount of water as is not returned to the sewers. The proceeds of this assessment are used for the care and maintenance of the sewerage works. The assessment for construction is subdivided into three classes. The first class is main drainage, main channels and other large works from which the whole city derives benefits. This is assessed according to land valuation. The second class is designated as district sewers or sub-mains, the assessment for which is made on district areas. The third class is lateral sewers, which are assessed on the frontage to the amount of $1.25 for each assessable foot, any case in excess of this amount being charged on the district area, and in case of any sewer costing less than $1.25 per foot the area is credited with the difference. The assessment for construction is the amount of the sinking fund charges and interest on 30 year bonds. The assessment is determined by the board of street commissioners each year, so that any defect in the plan can be corrected. It has been advantageous in enabling the city to do a vast amount of work that could not have been done under old methods.

A contract was made with the New England Sanitary Product company for the utilization of about 78 per cent. of the swill collected in Boston daily, the bulk of which was previously sold to farmers. The plant is located in an isolated section of the city known as the Cow Pasture. It is treating daily between 130 and 140 tons. Other sanitary arrangements have been made for the separation and disposal of combustible waste and a new dumping plant was established at Ft. Hill Wharf, for the handling of garbage.

The statistical data in the report is very complete, and many very fine illustrations, some of which are reproduced in this number of Municipal Engineering, add to its value and attractiveness.

New Publications.

Report on the Investigations into the Purification of the Ohio River Water for the Improved Water Supply of the City of Cincinnati, O., made by the Board of Trustees and Commissioners of Water Works.

The promptness with which the report appears in print is most commendable. The experiments closed in April, 1899, and the report appears early in December. The main investigation of the merits of the English and American systems of filtration for Cincinnati conditions extended from March 28, 1898, to Jan. 25, 1899, and the supplementary investigation of a special process proposed closed in April.

Full data of all kinds required and secured are given to demonstrate the conclusions of the report, which are stated in definite terms. The experiments being conducted by the same chemist and bacteriologist, Mr. George W. Fuller, as those at Louisville, no time was lost in tentative experiments and the fortunate occurrence of a year of average conditions makes the results generally applicable.

Ohio river water has much sediment of vegetable origin, but it is believed that the flow of large quantities of sand and clay through the water removes that which forms a coating on filter materials to increase the efficiency of their operation, since this action is almost entirely lacking in the Cincinnati experiments. This puts the English system, slow sand filtration, at some disadvantage in operation, which is increased at times by the enormous amount of clay which it carries in suspension at times of freshet, which occur for nearly or quite one-third of the average year. The decision is therefore against the system.

A trial of a modified form, using sulphate of alumina as a coagulant when needed and of the American system, mechanical filtration, demonstrated the practical adaptability of either system to this case. The easier control of the application of the chemical in proper quantities and the slightly less cost of the American system throws the decision in its favor. The special device proposed by an engineering company is not recommended.

The report reaches the same conclusion stated by the Pittsburg commission and has the definite comparison of the results of careful experiments to support it. The report is of great value and in connection with the Louisville report by Mr. Fuller

and the Pittsburg commission's report will supply material for making decisions upon the methods of treatment of the water supplies of many of our western cities. Mr. Fuller makes his reports so complete, each part in itself, that there are many repetitions of statements of fact and conclusions. While this makes a more bulky report, it makes it possible to get all one wants regarding one section of the report, if interested in but one, without reading the whole book, and so some individual time is saved for each reader.

A Treatise on Masonry Construction. By Ira O. Baker, John Wiley & Sons, New York. Price, $5.

This is a new and improved edition. The fact that it is the ninth edition is very good evidence of the appreciation of the work as a standard treatise. Some valuable new matter has been added by the author, including a chapter on cement, with the latest results in manufacture and testing. A new chapter has also been added on sand, gravel and broken stone, giving a scientific study of them as constituents of mortar and concrete. The author presents some tables showing the effect of different sands upon the strength of mortar. He has also made a sieve analysis and determined the voids and weight of a variety of sand, gravel and broken stone, showing the bearing of these results upon the strength and economy of mortar and concrete. A new chapter on mortar and concrete is given, in which the various methods of proportioning mortar are discussed, and a table shows the quantities of sand and cement required for a cubic yard of various proportions.

Railroad Curves and Earthworks. By C. Frank Allen, S. B., M. Am. Soc. C. E. Spon & Chamberlain, New York. Price, $2.

While this book meets the needs especially of students in engineering colleges, it will be helpful to engineers engaged in practice, and it is of a size that makes it suitable for carrying in the pocket in the field. A feature of much merit is the simplicity of the demonstrations, as well as the clearness and conciseness of mathematical statements.

Potable Water and Methods of Detecting Impurities. By M. N. Baker. D. Van Nostrand Co., New York. Price, 50 cents.

The author gives a very clear and practical review of what constitutes potable water, how it may be secured, how to detect impurities, and of chemical, bacterial and miscroscopical tests.

Fire-Proofing of Steel Buildings. By J. K. Freitag, C. E. John Wiley & Sons, New York. Price, $2.50.

As stated by the author, fire-proofing is still in the interesting stage of experimentation, and, as he says further, we know that a building can be only relatively fire and water proof. The author presents information helpful to a better knowledge of the subject and his recommendations for the designing and construction of buildings aim at the nearest approach to fire proof conditions now known.

The Use of the Slide Rule. By F. A. Halsey, C. E. D. Van Nostrand Co., New York. Price 50 cents.

The author explains the best methods of overcoming the difficulties of the slide rule, with the hope that his warnings against too rapid progress may do something to promote the use of what he regards as "the most valuable labor-saver within reach of the average constructing engineer."

Personal Notes.

A. E. Burkes has been appointed city engineer of Versailles, Ky.

B. F. Staples has been appointed city engineer of Shelbyville, Ky.

A. Jeffries has resigned his position as city engineer of Brenham, Tex.

Samuel E. Wilmer has been elected superintendent of water works at Woodbury, N. J.

John S. Waterman has been elected secretary of the drainage commission at New Orleans, La.

Walter B. Melins has been apointed city engineer at Albany, N. Y., to succeed Horace Andrews.

Paul Ilg, Davenport, Ia., has been elected county surveyor of Dubuque county. This is Mr. Ilg's fourth term in the office.

Charles Davis, M. Am. Soc. C. E., has been appointed county engineer of Allegheny county, Pennsylvania, for a term of three years.

C. T. Hayden has been appointed superintendent of the water department at Rome, N. Y. Mr. Hayden held this position from 1878 to 1889.

Alvin Boody, Brooklyn, N. Y., has been appointed superintendent of parks for the borough of Brooklyn and Queens, New York City.

Hirma F. Mills of the class of '56 of the Rensselaer Polytechnic Institute delivered a lecture recently before the institute on "The Filtration of Sewage and Water."

Samuel M. Gray, M. Am. Soc. C. E., Providence, R. I., has been engaged by the government as consulting engineeer on the sewerage system of Havana, Cuba.

Albert Sahm, Joseph T. Fanning and Joseph W. Smith have been appointed members of the new board of public works at Indianapolis, Ind., by Mayor Taggart.

H. C. Kellogg, Anaheim, Cal., will go to Honolulu, H. I., according to press reports, to act as consulting engineer in the construction of an irrigation reservoir and dam.

Capt. George Reyer has resigned his position as superintendent of water works at Narlinville, Tenn., to accept that of superintendent and general manager of water works at Birmingham, Ala. John Ahern has been chosen as his successor.

Ex-City Engineer Wingland of Sioux City died recently in an insane asylum, where he had been confined for several months. He was also city engineer at one time of Chamberlain, S. D.

William Boldenmeck has been re-elected president of the board of trustees of the sanitary district of Chicago. Other officers who hold are: F. M. Blount, treasurer; Joseph F. Haas, clerk; Charles P. Gilbert, attorney; Isham Randolph, chief engineer.

Thomas J. Montgomery, a member of the board of public works, Indianapolis, Ind., died Dec. 20, aged thirty-five years. Mr. Montgomery was twice elected councilman-at-large, but resigned two years ago to accept a position on the board of public works.

William L. Dickinson, Springfield, Mass., has tendered his resignation as superintendent of streets of that city. For ten consecutive years he has been elected to this position by the city officers. Mr. Dickinson also tendered his resignation as president of the Connecticut Valley Highway Association, which position he had held since it was first organized. In his letter of resignation he expressed himself as firmly of the belief that it was for the best interests of the association that the honors should be passed around. The letter was read at a meeting held Dec. 12, after which the nominating committee reported that the resignation would not be considered. The chairman of the committee said that Mr. Dickinson had discharged the duties of the office with such manifest credit to the association that his resignation could not be accepted, and he had therefore been placed at the head of the list of officers for president for 1900.

Rudolph Hering, M. Am. Soc. C. E., New York City, and Howard A. Carson, M. Am. Soc. C. E., Boston, Mass., have been appointed consulting engineers to examine and report to the city of Cleveland, O., and to the board of park commissioners regarding the building of an intercepting sewer in Doan Brook alley.

Henry A. Pressey has been appointed professor of civil engineering in the School of Graduate Studies of the Columbian university, Washington, succeeding Prof. Felix Freybold, resigned. Prof. Pressey is a graduate of the Massachusetts Institute of Technology, and has been connected lately with the U. S. Geological Survey.

Prof. Burdstal of the department of mechanical engineering of Mason college, Prof. J. H. Pomiting of the department of physics, and Director G. J. Kendrick are visiting the United States to obtain suggestions for their new engineering building. The engineering plant of the University of Pennsylvania is among those examined.

Trade Notes.

ASPHALT.

The Gest Asphalt Paving company has been incorporated at Cincinnati, O., by Guy M. Gest, George D. Eustis, B. D. Bartlett and Henry Burkhold. The company will build a new asphalt plant and will immediately begin bidding for city and country work.

Suit has been filed in the Circuit Court at Newport, Ky., by Sidney Seaman, manager of the Louisville Asphalt company, who is suing his late partner, Harry Spinks, for $30,000 as profits from Louisville and New Orleans improvement contracts.

The advisability of establishing and maintaining an asphalt plant for the repair of asphalt pavements is being considered by City Commissioner Varney of Baltimore. The city has a contract at present with the Southern Asphalt Company, but this expires Jan. 1.

BRICK.

The Patton Clay Mfg. company, Patton, Pa., is at work on an extensive addition to its plant.

L. C. Furley, vice-president of the Kentucky Fire Brick Works, Firebrick, Ky., wishes to buy a second-hand wet pan for grinding fire clay with either a wooden or an iron frame. He says that "on January 1, 1900, twenty-seven blast furnaces lined throughout with fire brick made by the Kentucky Fire Brick Works, will be in blast. The number of high-grade fire brick works in this country who can equal this record is exceedingly limited. The factory at Firebrick, while very old and of established reputation for its products, has been kept modern by the addition and adoption each year of any features calculated to improve the quality of the product or the excellence of its service to the company's patrons. It is one of the largest fire brick plants in the United States and is located in the midst of several thousand acres of celebrated Kentucky flint clays owned by the company."

The town of Albia, Ia., wants a paving brick plant established. An abundance of good clay is accessible, according to local press reports.

The Purington Paving Brick company, Galesburg, Ill., made the largest shipment of paving brick in the month of October, 10,250,000, that it has ever made in one month.

CEMENT.

The work of establishing a Portland cement mill near Florence, Col., has begun. W. H. James, J. O. Thatcher and W. F. Geddis are the owners.

Bids are asked until Jan. 1 and 2 for furnishing and delivering a quantity of Portland cement. Maj. F. V. Abbot, U. S. engr., Globe bldg., St. Paul, Minn.

The Whitehall Portland Cement company, Cementon, Pa., has awarded the contract for erecting seven large buildings to Longbridge & Mullen of Catasauqua, Pa.

The German Alsen Cement company, Hamburg, Germany, will send engineers to the United States, according to reports, to locate three cement plants near Nazareth, Pa.

A Portland cement plant is being erected at Wyandotte, Mich., by the Michigan Alkali company.

Cement works are proposed at Bedford, Ind., to utilize the oolitic limestone.

The Sandusky Portland Cement company is constructing a plant at Syracuse, Ind.

The Illinois Steel company, Chicago, has practically abandoned the manufacture of slag cement and will make Portland cement by grinding blast furnace slag with the necessary proportion of limestone and burning the mixture in rotary.

Designs have been made for a cement plant at Litchfield, Ky.

Cement plants are in course of construction near La Salle, Ill., by the Chicago Portland Cement company, the Marquette Cement company and the Hanover Portland Cement company of Germany.

The Omega Portland Cement company, Jonesville, Mich., is building a plant four miles north of that place of 500 barrels capacity. The plant will be in operation by April 1, 1900.

A tract of 325 acres of land suitable for the manufacture of cement, lying between Alton and Clifton, Ill., has been leased by capitalists of St. Louis, Mo.

Parties from Moline, Ill., have invetsed $75,000 in the Iola Portland Cement company, Iola, Kas.

George A. Arbley, assistant state geologist of Indiana, after a careful investigation of the marl beds in the vicinity of Silver Lake, Kosciusko county, has recommended that prospective manufacturers refrain from putting up mills of greater capacity than fifty barrels a day. The quantity is not as extensive as it was at first supposed to be.

William E. Morse of Detroit, Mich., has written to State Geologist Blatchley of Indianapolis, Ind., asking for information as to the best location for a marl plant in the state of Indiana. Mr. Morse claims that he represents a large company which wishes to locate in the state if good marl deposits can be found close to railroad facilities.

MACHINERY.

The Board of Public Work of Meriden, Conn., believes that the purchase of a small road roller would be of great value to the city in the construction and repairs of streets.

Fraser & Chalmers have sold one of their adjustable Comet Crushers to the Momence Stone company, Momence, Ill., owned by the Chicago & Eastern Illinois Railroad, after a severe competition with other gyratory crusher manufacturers. This crusher is the largest size built and is of enormous capacity, crushing 200 tons per hour to 2½-inch ring. The selection of the Comet machine was determined solely on its merits, the adjustable feature of this machine saving the putting in of another crusher to re-grind tailings and spalls. Any other make of gyratory crusher, owing to lack of adjustment, would have necessitated a smaller machine for grinding tailings. This adjustable feature is covered by broad patents of Fraser & Chalmers.

The O. H. Jewell Filter company, Chicago, Ill., reports that it has secured a contract from Cincinnati, O., for one of their Jewell Gravity Filter Plants. Also that Dennison, O., has placed an order to increase the Jewell Filter plant ordered last September.

The New York Filter Manufacturing company, 26 Cortlandt-st., New York has recently received the following orders: Contract from the town of Danville, Pa., for filter plant to purify the town water supply; contract from the town of Canton, Pa., for filter plant to purify the town water supply, and contract from town of Rocky Mount, N. C., for filter plant to purify the town water supply. The city of Norfolk, Va., for which the New York Filter Manufacturing company recently installed a filter plant of 6,000,000 gallons daily capacity, has contracted with them for filters to purify 2 000,000 gallons per day additional.

ELECTRIC LIGHT COMPANIES.

The Rensselaer Lighting company has been incorporated to manufacture gas and electricity for light, heat and power purposes in Rensselaer and Columbia counties, N. Y. The directors of the company are John T. Kirk, Brooklyn; Leonard B. Lampman, Coxsackie; Chas. W. Squires, New York City.

The Carbon County Improvement company's electric light plant, wagon works foundry, etc., at Weisport, Pa., were totally destroyed by fire Dec. 6. The loss is estimated at $100,000.

The Charlotte General Electric company, Charlotte, Mich., has been incorporated by J. C. Farrar, W. Farrar, W. H. Halleck, E. Halleck and H. A. Thomas, all of Brighton.

The G. W. Frey company, Minneapolis, Minn., has been incorporated to manufacture lighting apparatus.

The Lehigh Power company, Jersey City, N. J., has been incorporated to furnish water and construct and operate plants for furnishing electric light, heat and power. The incorporators are Geo. W. Griffiths, H. C. Caranaugh and C. N. King of Jersey City.

The Columbus Electric Light company, Jersey City, has been incorporated to furnish light to cities in the southern states. The incorporators are Charles N. King, John J. Mullaney and Albert McMahon, all of Jersey City.

Boston, Mass.—Mayor Quincy has signed a five-year contract with the Charlestown Gas and Electric Light Co., on the same basis of the contract with the Boston Electric Light Co. This is a sliding scale, making the price per lamp per night 35 cts. for not less than 2,365 and not more than 2,749 lamps. The contract with the Charlestown company will be about 34 cts. per lamp per night.

A combination is being formed among the three electric lighting companies of Los Angeles—the Los Angeles Electric company, the San Gabriel Electric company and the Edison Electric company—which has in view the division among them of the business of this city upon the basis of one-third to each.

A new method for calibrating the current of an alternating current instrument has been worked out by Carroll D. Jones of the physics department of the University of Michigan. A transformer is used. Less than one-twentieth as much energy is required in this method as in the ordinary industrial methods.

MISCELLANEOUS.

The University of Pennsylvania has received $250,000 for the erection and equipment of a physical laboratory for undergraduate and graduate work. Buildings are being designed which are valued at more than a million dollars.

At a meeting of the Springfield, Mass., City Council on Dec. 12, a resolution was adopted ordering the use of the Buckland iron paving block for transforming

tram head girder rails into full groove rails on the S. Main-st. line of street railway. This will include all of the tram head girder rails in Springfield and is a strong testimonial to the merits of the device from the city in which it was invented and first used. The order was made in compliance with a public demand after the successful experiment on Dwight-st. Mr. Buckland, the patentee, reports that he is receiving inquiries from all sections of the country regarding the device.

IMPROVEMENT AND CONTRACTING NEWS.

PAVING.

CONTEMPLATED WORK.

Schenectady, N. Y.—Paving is urged for Villa-st.

Atlantic, Ia.—Paving is contemplated. J. H. Boys.

Jacksonville, Ill.—Paving is proposed for the public square.

Pawtucket, R. I.—Asphalt paving is contemplated for Cottage-st.

Alton, Ill.—Garden and Manning-sts. will be paved in the spring.

Anoka, Minn.—A block of brick paving is contemplated as an experiment.

Wyandotte, Mich.—The question of paving Biddle-st. is being considered.

Jersey City, N. J.—The improvement of Newark-ave. is contemplated.

Belvidere, Ill.—Petitions are being circulated for asphalt paving.

La Crosse, Wis.—The council is taking steps toward securing new pavements.

Blanchard, Ia.—Paving is contemplated for the principal streets next year.

Hamilton, O.—The question of street paving is being urged for consideration.

Oshkosh, Wis.—Brick paving is contemplated for Main-st. and intersections.

Allegheny, Pa.—The council has recommended the improvement of several streets.

Moscow, Idaho.—The question of paving the business streets is being considered.

Saginaw, Mich.—A resolution has been passed to pave Lapeer-st. with brick.

Elkhart, Ind.—The Beardsley-ave. bridge will be paved with brick next spring.

Hartford, Conn.—A resolution has been passed to lay out Fern-st. H. F. Smith, cy. clk.

Toledo, O.—Paving is proposed for Summit-ave., from Galena-st. to Michigan-ave.

Annapolis, Md.—The council has been asked to issue $100,000 bonds for street improvements.

Upper Alton, Ill.—Paving is contemplated for Washington and Manning-sts. and College-ave.

Glenville, O.—The question of securing permanent paving for St. Clair-st. is being considered.

Cedar Rapids, Ia.—An asphalt roadway is contemplated for the proposed new bridge at B-ave.

St. Louis, Mo.—The council proposes to improve Kings Highway at a cost of about $80,000.

Los Angeles, Cal.—Ordinances of intention were passed Dec. 11 to improve certain streets.

Boone, Ia.—The property owners on S. Story-st. are urging the paving of that thoroughfare.

Flushing, (L. I.) N. Y.—The question of widening and extending S. Parsons-ave. is being discussed.

Petersburg, Ind.—The taxpayers of the county will vote on the question of building good roads Feb. 6.

Beaumont, Tex.—The question of issuing $50,000 bonds for road improvements will be voted on Jan. 9.

Galveston, Tex.—The question of issuing $90,000 street improvement bonds will be voted on Jan. 16.

Omaha, Neb.—The South Omaha Stock Yards company will pave its entire yards with brick, W. J. Kenyon, genl. mgr.

Atlanta, Ga.—The county commissioners have decided to co-operate with the city in the paving of Peters-st.

Bay City, Mich.—A resolution has been passed to pave First-st., from Washington to Sherman, with brick.

Springfield, O.—A resolution has been passed to pave Primrose and Skunk alleys with vitrified brick or blocks.

Moline, Ill.—An ordinance was passed Dec. 18 to pave Fourth-ave., Fourteenth-st. and Fifth-ave. with brick.

Darby, Pa.—The borough council decided in favor of good roads Dec. 4 and authorized a loan of $45,000 for that purpose.

Wilkinsburg, Pa.—The question of issuing $100,000 bonds to complete street improvements will be voted on in February.

Kansas City, Mo.—Ordinances were approved Dec. 15 for paving several streets in the West Bottoms with asphalt.

Hoboken, N. J.—Mayor Hoos has recommended that Washington-st. be paved with Belgian block and Blomfield-st. with asphalt.

St. Joseph, Mo.—The property-owners on N. Seventh-st. have been circulating a petition for the paving of that street.

San Luis Obispo, Cal.—The question of issuing $12,000 bonds for the construction of a public road will be voted on Jan. 9.

West Bay City, Mich.—City Engineer Bloomsfield has been directed to prepare estimates for paving Midland-st. with brick.

Spokane, Wash.—About 1¾ miles of paving on two streets is contemplated. The contracts have not yet been let. O. A. Weile, cy engr.

Toronto, Ont.—The city engineer recommends, in his annual report, that Brunswick-ave. be paved with asphalt and Front-st. with brick.

Syracuse, N. Y.—The city clerk has been directed to advertise for bids for paving N. Clinton-st. and Belden-ave. with asphalt.

Wapakoneta, O.—(Special.)—Samuel Craig, engr., says that a petition has been presented to the council to pave Anglaize-st.

Wabash, Ind.—(Special.)—Robt. P. Woods, cy. engr., says that a petition asking for 22,000 sq. yds. of asphalt paving on Hill-st.

has been presented to the common council.

Chicago, Ill.—The board of local improvements voted Dec. 14 to pave forty-five streets and alleys with asphalt, brick, granite, macadam and cedar blocks at an aggregate cost of $500,000.

Leavenworth, Kas.—Bids will be asked soon for asphalt paving in the North Esplanade and Shawnee and Main-sts. S. F. Neeley, mayor.

Milwaukee, Wis.—The Park Board has begun the condemnation of land for the Highland boulevard, which will be 3,400 feet long and 120 feet wide.

Quincy, Ill.—Estimates for paving Twelfth-st. have been prepared by the city engineer and will be considered by the local board Jan 2.

Trenton, N. J.—A petition has been presented to council asking that Center-st. be paved with asphalt, and with Belgian blocks between the tracks.

Louisville, Ky.—The board of public works will be asked by the council to change the asphalt specifications for the purpose of admitting competition.

Prospect Park, Pa.—This borough has decided to borrow $11,000 to be used for general improvements. The question will be submitted to vote in February.

Newport News, Va.—Plans are being prepared for improving a large number of streets, for which $250,000 will be expended next year. A. A. Moss, mayor.

Minneapolis, Minn.—The appropriation for paving during 1900 is $28,000. The paving committee will consider the question of paving several streets after Jan. 1.

Buffalo, N. Y.—The committee on streets will recommend the repaving of a large number of streets which require more repairs than one-third of the carriage way.

Toledo, O.—A petition has been circulated asking for the repairing of Jefferson-st., from Eleventh-st. to Collingwood-ave., with asphalt, asphalt block or brick.

Kansas City, Kas.—An ordinance has been passed to pave Ohio-st., from Fifth to Orchard, with Trinidad lake asphalt. E. R. Ireland, cy. clk., R. L. Marshman, mayor.

Albion, Mich.—The board of public works has been authorized to prepare estimates and specifications for paving Porter-st., between Superior and Clinton, with vitrified brick.

New Orleans, La.—Specifications have ben prepared for paving Chartres-st., from St. Ann to Elysian Fields-st. The city engineer was directed Dec. 17, to advertise for bids for paving Prytania-st., between Calliope and Clio, with asphalt.

Indianapolis, Ind.—Final action was taken Dec. 14, for paving an alley with brick and grading Twentieth-st. Petitions were filed Dec. 16, for brick paving on Ellsworth-st., from New York to Vermont-sts., but this was denied at a meeting held Dec. 20.

Rochester, N. Y.—Paving is contemplated as follows: Ontario-st., brick; Cortland-st., trap rock; Augustine-st. and Maple-st., asphalt. First ordinances have been introduced for paving a large number of streets with asphalt, brick, macadam and Medina stone.

Philadelphia, Pa.—An ordinance is pending which provides for the substitution of asphalt where blocks have neen used heretofore. Many of the streets that will be affected by the measure are in sections where the contracts have not yet been awarded. Chm'n Dixon, of Highway Com.

St. Paul, Minn.—The property owners on Rice-st., between College and University-aves., are taking active steps toward securing an asphalt pavement. The Board of Public Works had adopted an order to pave the street with brick, but it is believed the property owners will be successful in their efforts to have it held up.

Cleveland, O.—Resolutions were introduced Dec. 18 authorizing the director of Public Works to advertise for bids for paving as follows: Brick—Portions of E. Madison, Brainard, Buhrer, First, Giddings, Merchant, Miles, Sterling and Southern-aves., and Daisy, Professor and W. Clinton-sts. Asphalt—Burt, Bolivar and Bertram-sts. and Woodland-ave. Medina Stone—High, Hamm, Kirtland, Long and Ohio-sts.

Brooklyn, N. Y.—Ordinances have been approved for grading and paving, as follows: Laying out and extending Eightieth-st., between Narrow-ave. and Shore-road; granite block paving in Stanhope-st., between Myrtle and Hamburg-aves.; Macadam, D-ave., between Ocean and Coney Island-aves.; Asphalt, Cooper-st., between Hamburg-ave. and County line; granite blocks, Georgia-ave., between Liberty and Glenmore-ave.

CONTRACTS TO BE LET.

Fairview, N. J.—Bids are asked until Jan. 3 for grading Anderson-ave. F. B. Wallace, boro. clk.

Cincinnati, O.—Bids are asked until Jan. 16 for improving several streets. G. H. Spellmire, cy. clk.

Roanoke, Va.—Sealed proposals will be received until Jan. 6 for laying slag and brick walks on sundry streets. W. E. Thomas, clk. coun.

South Bend, Ind.—Sealed bids will be received until Jan. 8 for constructing asphalt, brick and creosoted wooden block paving and cement curbing in several streets. L. A. Hull, cy. clk.

Kansas City, Mo.—Bids will be received until Jan. 2 for constructing natural stone sidewalks on Montgall-ave., between Twenty-fifth-st. and Twenty-sixth-st. H. A. Wise, Cy Engr. Bids were received Dec. 20 for paving the middle section of Benton boulevard, between Fifteenth and Twenty-fourth-sts., from Frank McMillan and Collier Bros., but they were rejected and the bids will be re-advertised for.

McConnellsville, O.—John C. Bolen, Zanesville, secured the contract for paving Center-st. with brick for $13,600.

Buffalo, N. Y.—The contract for paving Swan-st. with asphalt has been awarded to the American Contracting company for $32,750.

Independence, Kas.—The contract for paving the business streets with vitrified brick was awarded, Dec. 12, to J. W. Glass.

Clinton, Ia.—The contract for macadamizing Second-ave. was awarded to J. I. Devine and P. C. Donahue at 98 cents a sq. yd.

Spokane, Wash.—The Alcatraz Paving company of California secured the contract for paving four streets with asphalt for about $40,000.

Elgin, Ill.—A. E. Rutledge & Co., Rockford, have been awarded the contract for

paving Chicago-st. with Galesburg brick for $16,000.

Allegheny, Pa.—Booth & Flinn secured the contract for paving Clayton-ave. and Catawba-st. for $2,557 and $1,545 respectively.

Benton Harbor, Mich.—The Barber Asphalt Paving company has been awarded the contract for paving Pipestone-st. with asphalt at $1.73 a sq. yd.

Petersburg, Va.—The Barber Asphalt Paving company, New York City, secured the contract, Dec. 12, for 7,500 sq. yds. of asphalt paving in S. Sycamore-st. at $2 a sq. yd.

Harlem, Ill.—The contract for paving Madison-st. has been awarded to Charles M. Porter, River Forest, Ill., for $13,840. Metropolitan Canton brick will be used.

Wilmington, Del.—The Delaware Granite and Mining company of this city has been awarded a contract for the construction of roads and bridges in Porto Rico for $250,000.

Mishawaka, Ind.—(Special.)—The contract for 1½ miles of asphalt paving in Second-st. has been awarded to the Western Paving and Supply company of Chicago at $1.89 a sq. yd.

Rochester, N. Y.—Whitmore, Rauber & Vicinus secured the contract, Dec. 15, for Medina block paving in Elm-st., between the street car tracks and two feet outside thereof, for $6,385.60.

Omaha, Neb.—The Grant Paving company submitted the lowest bid for asphalt paving in Ames-ave., from Twenty-fifth-st. to Thirtieth-st., at $2.37 a sq. yd., and Edward Phelan for brick paving at $1.77.

Buffalo, N. Y.—The contract for paving Niagara-st., from Front-ave. to Porter, with asphalt, was awarded Dec. 12 to the German Rock company for $10,993. H. P. Burgard was the lowest bidder for paving May-st.

Asheville, N. C.—The contract for 11,664 sq. yds. of brick paving has been awarded to the Tennessee Paving Brick company at $1.47 a sq. yd. The contract for the N. Court Square paving has not been awarded. B. M. Lee, cy. engr.

New Albany, Ind.—Bids were received Dec. 4 for asphalt paving on Main-st. as follows: Western Paving and Supply company, Indianapolis, preparing old macadam, 9 cts. a sq. yd.; new binder, 70 cts. a lin. ft.; Trinidad asphalt on macadam and binder, $1.66 a sq. yd. Barber Asphalt Paving company, macadam, 11 cts.; new binders, 50 cts.; asphalt, $1.59.

Brooklyn, N. Y.—Bids were received Dec. 21 for paving two sections of Bedford-ave. with asphalt on concrete, with 5 yrs. guarantee, as follows: Crawford & Co., Brooklyn, asphalt, $1.80; old stone pavement, 30 cts.; concrete, $4.50; new curb, 80 cts.; old curb, 35 cts.; granite paving, 75 cts. Eastern Bermudez Asphalt company, New York City, asphalt, $1.93; old stone pavement, 30 cts.; concrete, $4.80; new curb, 85 cts.; old curb, 35 cts.; granite paving, 65 cts. Brooklyn Alcatraz Asphalt company, asphalt, $1.85; old stone pavement, 35 cts.; concrete, $4.75; new curb, 80 cts.; old curb, 35 cts.; granite paving, 75 cts.

SEWERS.

Newark, N. J.—It is feared that the Passaic river will be ruined for commerce in 20 years if this city does not remove each year the sewage silt it empties into the river.

Havana, Cuba.—The council voted, Dec. 5, to reject the contract obtained by Michael Dady of New York City, for constructing sewers in this city. It has been the opinion of army officials for some time that this contract was not only void but that it would entail great extravagance on the city. The matter was left to the municipal council, however.

CONTEMPLATED WORK.

Tipton, Ia.—About $4,500 will be expended for new sewers.

Wyandotte, Mich.—A 10 mi. crock sewer will be constructed in First-st.

Marcus Hook, Pa.—A sewerage system has been recommended for this borough.

Sherman, Tex.—The citizens are in favor of a municipal sewerage system.

Media, Pa.—The question of building a sewerage system is urged by the press.

Reading, Pa.—An expenditure of $100,000 for new sewers in 1900 is proposed.

Dunmore, Pa.—Main and lateral sewers are contemplated at a cost of $60,000.

Merced, Cal.—A sewerage system is proposed for next year. W. H. Turner, mayor.

Upland, Pa.—The question of building a sewerage system is being discussed again.

Savanna, Ill.—Plans have been submitted to the council for a sanitary sewer system.

Springfield, Mass.—A resolution has been passed for a sewer in Cherryln-ave.

Spokane, Wash.—A petition is being circulated asking for sewers in the Fourth ward.

Marshalltown, Ia.—The improvement and extension of the sewerage system is proposed.

Davenport, Wash.—The construction of a main sewer on Morgan-st. is urged by the press.

Rossville, Kan.—Surveys have been made for a sewerage system by John Rogers, co. surv.

Walla Walla, Wash.—An engineer will be employed to prepare plans for a sewerage system.

Ft. Wayne, Ind.—The Board of Public Works has ordered the construction of three sewers.

Sag Harbor, L. I.—The question of building a sewerage system will be voted on in January.

Marshfield, Wis.—Plans have been prepared for a sewerage system by John Icke and M B. Stone.

Bayonne, N. J.—Ordinances have been passed for sewers in W. Twenty-fifth and Forty-fifth-sts.

Waycross, Ga.—The estimated cost of the proposed sewerage system is $36,000. R. P. Bird, clk. com.

Murphrysboro, Ill.—About $9,000 will be expended in a sewerage system. R. O. Deason, cy. clk.

Harrison, N. J.—An ordinance was passed Dec. 5 for building a sewer in Third-st., from Warren to Bergen.

Lakewood, O.—Plans have been prepared for a combined sewerage system. Henry W. Elliott, chmn. com.

Darby, Pa.—Bids will probably be asked soon for building a number of sewers. A. L. Gotshall, ch. burgess.

Augusta, Me.—Plans are being prepared for new sewers. L. A. Burleigh, cy. clk.; W. B. Getchell, cy. engr.

Terrill, Tex.—The Terrill Industrial Association is gathering data and general information relative to sewerage.

West Haven, Conn.—A committee has been appointed to investigate the advisability of a system of sewage disposal.

Alexandria, La.—The plans prepared by City Engineer Silvester for a sewerage and drainage system have been indorsed.

El Paso, Tex.—A 6 ft. storm water sewer through Oregon-st., a distance of one mile, is contemplated, at a cost of $40,000.

Oelwein, Ia.—Plans and specifications for a sewerage system will be prepared by M. Tschirgi, Jr., C. E. of Dubuque, Ia.

East Orange, N. J.—The construction of sewers, at an estimated cost of $5,000, is contemplated. Wm. H. V. Reimer, cy. engr.

Webster, Mass.—The preliminary work on the main outfall sewer will begin this winter. Chas. Haggerty, chmn. sewer board.

Glenville, O.—Plans are being prepared for the establishment of two new sewer districts in the east end; estimated cost, $50,000.

Bridgeport, Conn.—The estimated cost of a sewer to drain the section in the vicinity of Beardsley Park is $40,000. Cy. Sur. Scofield.

Tacoma, Wash.—Estimates will be prepared by the city engineer for a sewerage system in South Tacoma; estimated cost, $500,000.

McKeesport, Pa.—Ordinances will be introduced in the council providing for an appropriation of $225,000 for the construction of sewers.

Beaver Falls, Pa.—The question of building a complete sewerage system will be voted on in the spring. W. J. Davidson, chmn. sewer com.

Columbus, Ga.—The committee on sanitation has recommended that the council consider the advisability of building a sewerage system.

Helena, Ark.—The council is considering an ordinance defining the sewer district for the purpose of constructing a sewerage system.

Graceville, Minn.—The citizens voted, at a recent mass meeting, in favor of building a sewer in Studdart-ave. R. A. Costello, chmn. com.

Louisville, Ky.—The Board of Public Works will ask the General Council for an appropriation of $1,000,000 for sewer construction in 1900.

Passaic, N. J.—The construction of about 30,000 ft. of 8-in. pipe and 10,000 ft. of 20-in. pipe is contemplated. C. R. Wise, cy sur.

Highland, Park, Mich.—The council decided Dec. 11, to build two new lateral sewers, as follows: Farrand-ave., 7,000 ft.; Jarold-ave. 1,750 ft.

Dayton, O.—Plans have been submitted by T. G. Turner, cy. engr., for about ten miles of sanitary sewers and pumping stations in the suburb of Riverdale.

Sea Isle City, N. J.—The council decided, Dec. 7, to put in a sewerage system under the control of the municipality instead of granting a franchise for one to a corporation.

Haddonfield, N. J.—The council is considering a resolution providing for the payment of $30 for the best plans and estimates for a sewerage system.

Roswell, N. M.—The question of issuing $27,000 bonds for the construction of sewers will be voted on Jan. 16. Hiram Phillips, St. Louis, Mo., cons. engr.

Quincy, Ill.—The city engineer estimates the cost of the proposed storm water overflow in the southeastern part of the city at $20,000. It will be about 6,000 ft. long.

Kansas City, Kan.—Resolutions have been passed to construct sewers in sub-sewer district No. 2, sewer dist. No. 19, sub-sewer dist. No. 8, and sewer dist. No. 14.

Memphis, Tenn.—The city administration contemplates the construction of 60 mls. of sewers next year, which will complete the system of this city. City Engr. Bell, Mayor Williams.

Oswego, N. Y.—The objections raised in this city regarding the deposit of Fulton's sewage in the river may result in the erection of disposal plant at a cost of about $20,000.

St. Louis, Mo.—Ordinances were adopted, Dec. 1, for the reconstruction of the Ann-ave. sewer, from Eighteenth to Dolman-st. and for 35 manholes and sewer inlets; estimated cost, $5,300.

Boston, Mass.—The Metropolitan Sewerage commission has asked for $95,000 for the north Metropolitan system, $49,000 for Charles river system, $25,000 for Neponset valley system.

Kansas City, Mo.—Plans are being prepared for sewering about 1,200 acres next spring and summer, in the new territory acquired when the city limits were extended. H. A. Wise, cy. engr.

Jersey City, N. J.—The construction of cast iron pipe sewers in Grand-st. and Fairmount-ave. for storm water only has been recommended by Charles A. Van Keuren, ch. engr. of the Street and Water Board.

Wilmington, N. C.—The chairman of the finance committee has been directed to ascertain the feasibility of having a private corporation construct a sewerage system, to be leased by the city for a term of 30 years.

Wabash, Ind.—(Special)—Robt. P. Woods, cy. engr., says that plans are being prepared for a sewerage system for the Northern district. It will be necessary to arrange for the partial purification of the sewerage.

Brooklyn, N. Y.—At a meeting of the local Board of Improvements for the Fifth district, Dec. 14, it was decided to recommend that sewers be constructed in Seventy-fifth, Seventy-first, Eighty-sixth and Seventy-ninth-sts. and Second, Fifth and Sixth-aves.

Swampscott, Mass.—The special committee on sewerage reported, Dec. 4, in favor of the sewerage system designed by Rudolph Hering and $11,000 was appropriated for use by the committee in making further surveys. The committee will report at the annual town meeting in March.

Cleveland, O.—City Engineer Ritchie estimates that more than a half million dollars will be saved to the citizens of this city on one branch of the intercepting sewer system if the city is permitted to build the Doan-st. sewer through Rockefeller park and is allowed to overflow the storm water in Doan brook.

Columbus, O.—A committee has been appointed to consider the question of establishing a sewerage disposal plant. Engineer Alvord has prepared two plans—charcoal filtration and precipitation. He estimates the cost of beginning the work at $300,000 and the total cost at $1,000,000.

Newark, N. J.—Local press reports state that a change will probably be made in the joint outlet sewer scheme, in which Newark, Irvington, Millburn, West Orange, Vailsburg, Summit and South Orange village and towaship are interested. The South Orange village board of trustees want another engineer appointed to examine the plans.

Columbus, O.—Director Kauffman, of the department of public improvements, has proposed a plan for the improvement of the sewerage facilities for business property fronting on Long-st., from Fifth-st. to Garfield-ave. He suggests a central relief sewer about 2 mis. long, with branches in all parts of the city, making a total of 7 mis.; estimated cost, $228,000.

CONTRACTS TO BE LET.

Buffalo Lake, Minn.—Bids will be received until Jan. 4 for building a tiled ditch. J. A. Soderquist, vil. rec.

Salisbury, N. C.—Bids are asked until Jan. 9 for building sewers and furnishing sewer pipe. S. F. Lord, mayor.

Cincinnati, O.—Bids are asked until Jan. 16 for sewers and drains in several streets. Samuel Neiman, prest. B. C. A.

Gastonia, N. C.—Sealed proposals are asked until Jan. 11 for constructing a sewer and water works system. John F. Love, clk.

Elkhart, Ind.—Sealed bids are asked until Jan. 9 for building a sewer in Pacific-st. D. F. Cordrey, cy. c. e.

Marion, Ind.—Sealed bids will be received until Jan. 2 for the construction of sewers in Thirty-eighth and Twenty-second-sts. Cyrus G. Robbins, cy. clk.

Williamsport, Pa.—Bids are asked until Jan. 11 for building 2,240 ft. of 24-in. and 1,700 ft. of 20-in. double strength pine house sewers in Circle-st. and Dewey-ave.; also a storm sewer in Church-st. Theo. Cornman, cy. clk.; George D. Snyder, cy. engr.

Elizabeth, N. J.—Sealed proposals are asked until Jan. 2 for building 315 ft. 2x3 ft. brick, 515 ft. 18-in. pipe sewer, 30 6-in. connections, 470 ft. 12-in. pipe sewer, 32 6-in. connections, 11 man-holes, 6 catchbasins and 150 ft. culvert. N. K. Thompson, st. com'r.

Verona, Pa.—Sealed proposals will be received until Jan. 1 for making a general sewage plan for this borough. The work will consist of making a survey of all streets and a plan of the same, placing stone monuments at such points as may be determined; taking levels, making profiles of all streets, showing size and depth of proposed sewers, location of all outlets, manholes, etc., and preparing a full plan of the same; a contract and specification fully describing the manner of constructing the system. Dr. George H. Scott, 1512 Penn-ave., Pittsburg.

CONTRACTS AWARDED.

Alliance, O.—The only bid received Dec. 15 for a sewage disposal plant for the Fairmount Children's Home, was from the Alliance Bacterial Purifying and Cleansing company of Alliance, for $3,990.

Harrison, N. J.—Breen & Tierney were awarded the contract for short sewers in Cleveland-ave. and Third-st.

Toledo, O.—Geo. L. Holder submitted the lowest bid, Dec. 18, for sewers in two alleys, at $1,310.80 and $1,160.35 respectively.

Greenville, Miss.—The contract for building a sewerage system has been awarded to Irwin Bros., of Greenville, O., for $41,584.

Lexington, Ky.—Dolan & Sons secured the contract for building a sewer in E. Fourth-st., from Race to Ohio, at 43½ cents per running foot.

Tarboro, N. C.—Guild & Co., Chattanooga, Tenn., secured the contract for building a sewerage system for $7,259, and Montague & Co. for furnishing pipe, for $2,519, in this city.

Boston, Mass.—The contract for a 72,000,000 gal. pump to be erected at the sewerage pumping station, Cow Pasture, was awarded, Dec. 20, to the I. P. Morris company of Philadelphia, for $219,400.

Brooklyn, N. Y.—Bids were received, Dec. 20, for repairing sewers in Warren, Smith, Hoyt and Wycoff-sts. as follows: Thomas Wade, $16,601; John J. Creem, $15,462 (recommended for award); Henry Hesterburg, $19,808; William McGarry, $16,852; John J. Malone, $19,090.

New York City—Bids were received Dec. 12 for sewers in Reid and Stuyvesant-aves. and Monroe-st., Brooklyn, and that of L. R. Clapp of this city, $15,883, was recommended for award. Other contracts recommended for award on the same date were: E. One Hundred and Sixty-first-st., Bronx borough, John J. McQuade, $11,414; Crane-st., Bronx borough, $9,610, Thielman & Smith. The contract for the Broadway-st. sewer was awarded to Bart Dunn, Dec. 9.

Buffalo, N. Y.—The granting of the Hamburg canal property to Michael J. Burke was adopted by the Board of Aldermen upon the terms that he construct a main sewer in the bed of the canal, with necessary bulkheads; fill in the prism of the canal; construct pumping plant and apparatus; construct a complete system of sewers for dry weather sewage and storm flow, necessary to drain this territory; construct a union railway station to cost not less than $1,500,000.

Pittsburg, Pa.—Bids were received, Dec. 18, for 1,822 lin. ft. 24-in. pipe sewer, as follows: Ott Bros., pipe, $4.75; drop stone covers, $85; manholes, $45. Cronin & O'Herron, pipe, $4.68; drop stone covers, $78; manholes, $38. Lee & Casey, pipe, $4.95; drop stone covers, $79; manholes, $34. Sweeney & Houston, pipe, $4.95; drops, stone covers, $75; manholes, $35. James H. McQuade, pipe, $4.95; drops, stone covers, $75; manholes, $35. Keeling & Ridge, pipe, $4.75; drops, stone covers, $75; manholes, $25.

WATER-WORKS.

Pekin, Ill.—The question of municipal water works was defeated Dec. 12.

Cedar Rapids, Ia.—This city has voted in favor of municipal ownership of the water works.

Paterson, N. J.—An ordinance was introduced Dec. 11 providing for the granting of a franchise to the People's Water company.

Municipal ownership of water works is contemplated at the following places: Utica, N. Y.; Omaha, Neb.; Racine, Wis.; Livingston, Mont.; Horton, Kan.

Columbus, O.—Wm. R. Hill, Syracuse, N. Y., has rendered a report on the scheme of supplying water from Lake Erie to Cincinnati and intermediate points. The first project, including Columbus, Dayton and Cincinnati, is estimated at $18,000,000, and an independent line to Columbus is estimated at $6,500,000. These figures are based upon the prices current in 1897.

Newly incorporated: Bryn Mawr Water company, Bryn Mawr, Cal.; Randsburg Water company, Johannesburg, Cal.; Reedsville Water company, Reedsville, Pa.; Canawacta Water Supply company, Susquehanna Depot, Pa.; Yucalipe Land and Water company, Los Angeles, Cal.; West Side Water company, Charleroi, Pa.; Citizens' Water, Heat, Light and Power company, Irvington, N. J.; Park Heights Land and Water company, Passaic, N. J.; South Side Water Works company, Mercer, W. Va.; People's Water company, Milroy, Pa.; Harvey Water and Light company, Portland, Me.; Lamar Light and Water company, Lamar, Mo.

CONTEMPLATED WORK.

East Liverpool, O.—The purchase of a new pump is contemplated.

Ft. Wayne, Ind.—An ordinance is being prepared for securing a pure water supply.

Peabody, Mass.—The sum of $15,000 has been appropriated for a larger water supply from Spring Pond

Rock Island, Ill.—The city nas been asked to purchase the necessary apparatus to test the water supply.

LaSalle, Ill.—Mayor McNamara favors the construction of a new supply conduit, new boilers and a new dynamo.

Owosso, Mich.—The introduction of water meters is proposed at a cost of $1,000. John S. Ash, cy. clk.

Canonsburg, Pa.—Plans and specifications for water works, sewers, etc., will be made by Jas. S. Haring of Crafton.

The question of issuing water works bonds will be voted on as follows: Enid, Okla., Jan. 28; Pawnee, Okla.; Yreka, Cal., Jan. 9

Monmouth, Ill.—About $30,000 will be expended in making improvements to the water works plant. W. P. Graham, chmn. water com'n.

New Ulm, Minn.—Plans will be secured for two new boilers for the water works pumping station and bids will be asked. Supt. water works.

Hyattsville, Md.—Information is desired regarding propositions for a water supply to be furnished by outside capital.

Grand Rapids, Mich.—The Jewell Filter company, Chicago, has made a proposition to install a complete mechanical filter plant at the present pumping station, for $320,000.

Rankin, Pa.—The water and sewer committee was authorized Dec. 19 to purchase material for the water mains that are to be built in the aqueduct of the Monongahela Street Railway.

The construction of water works systems is contemplated at the following places: Apple River, Ill.; Auburn, Neb.; Pratt City, Ala.; Water vliet, N. Y.; Burton, O.; St. Michaels, Md.; Georgetown, Del.; Mulhall, Ok. T.; Ponca City, Ok. T.; Dickinson, N. D.; Cadiz, Ky.; Ellsworth, Wis.; Burns, Or.; Laurel, Md.; Waterville, Kas.; Cherryfield, Me.; Kents Hill, Me.; Markesan, Wis.

Peoria, Ill.—The fire, water and light committee of the village Board of Trustees in Peoria Heights is in correspondence with several companies regarding the installation of a corporation water plant.

Batavia, O.—The bids for constructing a water works and electric light plant were rejected Nov. 25. Another vote will probably be taken in January, for additional bonds will be required before new bids are asked. A. T. Johnson, sec. bd. trustees.

CONTRACTS TO BE LET.

Carbondale, Ill.—Bids are asked until Jan. 2 for a water works system. F. M. Caldwell, cy. clk.

Ada, Minn.—Bids will probably be advertised about Jan. 1, to be opened Feb. 1, for building water works. F. M. Calkins, rec.

Gastonia, N. C.—Bids are asked until Jan. 11 for constructing a water works system W. H. Lewis, mayor; John F. Love, town clk.

Holland, Mich.—Sealed proposals will be received until Jan. 15 for furnishing a boiler for the Holland City Water Works and Electric Light plant. Wm. O. Van Eyck, clk. B. P. W.

CONTRACTS AWARDED.

Conneaut, O.—The contract for a filter plant has been awarded to the O. H. Jewell Filter company of Chicago, Ill.

Ponca City, Ok.—The contract for building water works has been awarded to R. J. Edwards of Oklahoma City for $25,325.

Danville, Pa.,—The contract for a filter plant to purify the water supply was awarded to the New York Filter Mfg. company, New York City.

Norfolk, Va.—The New York Filter Manufacturing company has been awarded the contract for a filter plant of 2,000,000 gallons a day, in addition to the 6,000,000-gallon plant recently installed by the same company.

BRIDGES.

Lacon, Ill.—The construction of a new bridge is contemplated. John I. Thompson, Mayor.

Little Britain, Pa.—A concrete and steel bridge across Octoa creek is contemplated.

Malvern, Ark.—A bridge will be built across the Ouachita river at Rockport. D. S. McCray.

Scranton, Pa.—An ordinance was introduced Dec. 14 to build a viaduct on W. Lackawanna-ave.

Bloomsburg, Pa.—The Board of Viewers has reported in favor of a bridge over Raven creek, Benton Twp.

Crawfordsville, Ind.—Plans and specifications have been ordered prepared for a bridge over Black Creek. Wm. W. White, co. audt.

Montezuma, Ia.—Bids are asked until Jan. 2 for the construction and repair of bridges during 1900. Alex. Duffins, co. audt.

Charles City, Ia.—Bids are asked until Jan. 3 for the construction and repair of pile and

combination bridges during 1900. W. D. Lindaman, Co. Audt.

Oskaloosa, Ia.—Bids will be received until Jan. 10 for building all iron and wooden bridges during 1900. J. B. Cruzen, co. audt.

Wellsboro, Pa.—The Wrought Iron Bridge Co., Canton, O., has been awarded the contract for a steel bridge 119 ft. long with 16 ft. roadway.

Albany, N. Y.—Bids are asked until Jan. 3 for a steel bridge over Erie canal at Chapel-st., Lockport. A lift bridge over Erie canal at Catherine and Almond-sts., Syracuse.

PARKS.

Atlantic City, N. J.—The city council has adopted a form of deed which, upon being signed, will convert the ocean front into a public park.

St. Paul, Minn.—A resolution was passed Dec. 18, to condemn twenty acres of land on the river bank near Summit-ave., for a park, to be known as Shadow Falls Park.

Indianapolis, Ind.—The Park Board accepted, Dec. 8, the offer of the New York Investment company to build a river driveway, beginning at New York and Blake-sts., and running west and north to the point where Michigan-st. crosses White river. Small parks will be laid out at regular intervals along the driveway and will be deeded to the city.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Albany, N. Y.—Bids for garbage disposal have been authorized.

Peoria, Ill.—The erection of a garbage crematory is contemplated.

Canton, O.—Plans and specifications for a crematory plant have been adopted.

East Liverpool, O.—Plans for a new garbage crematory have been agreed upon.

New Orleans, La.—The council has been asked to appropriate $2,500 for a street sweeper.

Salem, Pa.—The contract for street cleaning and collecting garbage has been awarded to G. H. Giles.

Hoboken, N. J.—A resolution has been passed to issue $4,000 bonds for street cleaning purposes.

York, Pa.—An ordinance appropriating $7,000 for the enlargement and improvement of a garbage crematory will be voted on Feb. 20.

Mt. Vernon, N. Y.—Aldermen Weber, Merrill and Fletcher have been appointed a committee to consider the question of cremating garbage.

Jamaica (L. I.), N. Y.—The contract for cleaning the streets and removing ashes and garbage during 1900 has been awarded to Thomas Foley.

Ithaca, N. Y.—A report has been submitted to the Business Men's Association by the sub-committee of the Committee on Legislature, recommending the collection and cremation of garbage by the city. The present contract expires in February, 1900.

Indianapolis, Ind.—Bids were received Dec. 27 for cleaning the paved streets of this city. The bid of the Capital Sweeping company, $50,000, was the only one within the appropriation, but the figure was just the same as the appropriation, and the season under which it was made only runs from March 15 to Dec. 15. Of the bids received two only were considered. One was to sweep the streets during 1900 at so much per 10,000 square feet, and the other was to keep the city clean for a gross amount, subject to penalties for inefficient service. This latter method is not favored by the Board.

STREET LIGHTING.

Yonkers, N. Y.—A municipal lighting plant is recommended by Mayor Sutherland.

Gastonia, N. C.—Bids are asked until Jan. 11 for an electric light plant. John J. Love, town clk.

Oakland, Cal.—Bids are asked until Feb. 5 for a franchise for lighting in Costra county. J. E. Rodgers, co. clk.

Denver, Col.—Mayor Johnson has proposed that a company build a lighting plant and then sell it to this city.

Alliance, O.—W. H. Morgan is chairman of a committee appointed to secure estimates for an electric light plant.

Muskegon, Mich.—A committee has been appointed by the council to investigate the cost of a modern electric light plant.

Brownstown, Ind.—The council passed a resolution Dec. 26 to purchase the water and light plant recently erected.

Toledo, O.—The contract for lighting the streets of this city has been awarded to the Traction company at $83 per year per lamp.

Quincy, Ill.—The council has adopted a proposition, submitted by the Quincy Gas and Electric Light company, which calls for 325 street lamps at $60 per lamp for three years.

Wichita, Kas.—A franchise for electric lighting was given to W. B. McKinley Dec. 18 calling for 179 arc lights and 40 incandescent lights at $12,000 per year for five years.

Corry, Pa.—(Special.)—G. D. Gilbert, cy. engr., says this city expects to contract in the near future for 80 arc lights to light the streets of this city for a term of ten years.

Milwaukee, Wis.—Sealed bids are asked until Jan. 15 for furnishing and maintaining lights by electricity or other illuminant for 1, 2, 3 or 5 years. Chas. J. Poetsch, chmn. com'rs. pub. wks.

Council Bluffs, Ia.—The lowest bid submitted, Dec. 16, for electric lighting, was that of Ervin Dryer of Chicago who agreed to furnish arc lights of the Manhattan series for a yearly rental of $69 each. Action was deferred.

Electric light plants are contemplated at the following places: Plainville, Conn.; Falconer, N. Y.; Valley Stream, L. I.; Biwabik, Minn.; Heward, S. D.; La Grange, Ga.; Skaneateles, N. Y.; Rollins, Wyo.; Patten, Me.; Van Buren, Me.; Horseheads, N. Y.; Hampton, Va.; Gurley, Ala.

Brooklyn, N. Y.—Bids were opened, Dec. 22, for contracts for lighting the public buildings, parks and thoroughfares of this city during 1900. The Edison Electric Illuminating Company bid 35 cts. per night for each 1,200 c. p. lamp, providing the total was not less than 4,000; 18 cts. per 600 c. p. lamp for 4,000 lamps; 34 cts. for 1,200 c. p. for over 4,000 lamps; 17 cts. for 600 c. p. This was the lowest bid received.